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NAVAL ACADEMY ANNAPOLIS MD

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SUMMARY OF RESEARCH ACTIVITIES. ACADEMIC DEPARTMENTS, 1979-1980--ETC(U)

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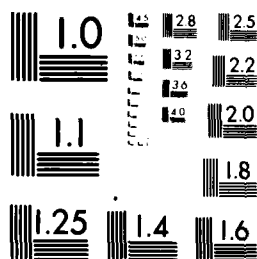
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SUMMARY OF
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ACADEMIC
DEPARTMENTS

1979-1980

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SUMMARY
OF
RESEARCH ACTIVITIES

1979-1980

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COMPILED AND EDITED
BY
PROFESSOR WILSON L. HEFLIN
ENGLISH DEPARTMENT

OCTOBER 1979

UNITED STATES NAVAL ACADEMY
ANNAPOLIS, MARYLAND
21402

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FOREWORD

The academic excellence of an educational institution is measured by the achievements of its faculty in teaching, research, and related scholarly endeavors. It is the policy of the Naval Academy to provide and maintain an environment in which research activities that contribute to the professional growth of the faculty and outstanding midshipmen may flourish.

The research activities of the faculty range from very applied cooperative studies with the Navy research and development community to very fundamental investigations concerned with extending the frontiers of knowledge. The broad scope of research described in this annual report reflects the interests and expertise of the participating faculty and midshipmen, as well as the availability of laboratory, library and computer facilities.

This publication was compiled to acquaint the reader with faculty and midshipmen research efforts being done behind the classroom scene. Research results are published in manuscripts, reports, and prestigious journals as well as presented at important professional meetings and conferences. In addition to their teaching and research, the faculty contribute to their profession through participation in professional societies and consulting activities. This publication contains summaries of completed and on-going faculty projects, midshipmen research course projects including the Trident Scholar Program, and lists of presentations and publications. The work reported on was conducted during the period 1 July 1978 through 30 June 1979.

External support continues to increase significantly. This is undoubtedly due to the additional opportunities provided by new laboratories in the Engineering Studies Complex and the initiative of the well-qualified civilian and military members of the faculty. It is important to acknowledge the strong and continuous support provided by the Chief of Naval Research, Chief of Naval Development and the numerous activities of the Naval Material Command, without which such progress could not be possible.

Comments and suggestions related to the research efforts will be gratefully received and sincerely appreciated.



BRUCE M. DAVIDSON
Academic Dean



RICHARD D. MATHIEU
Director of Research

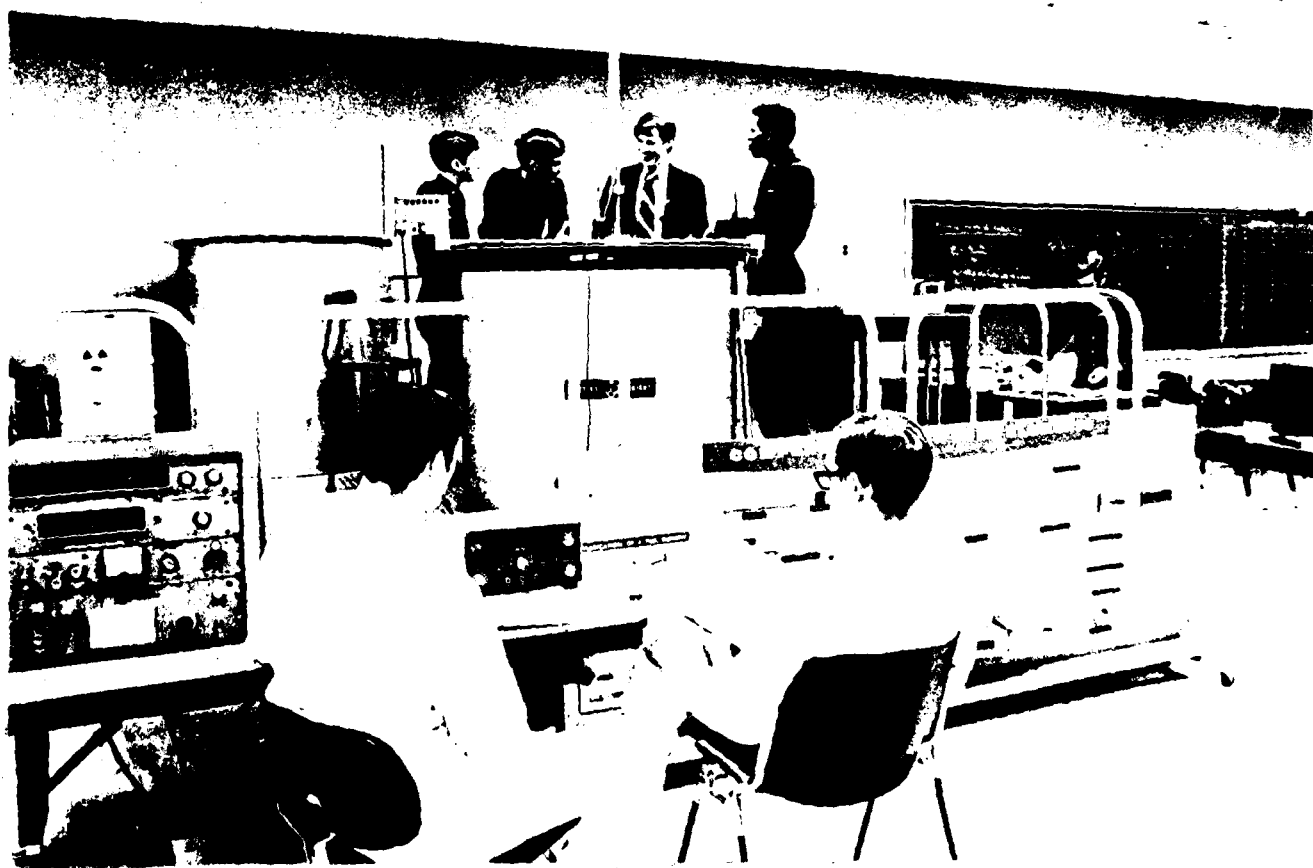
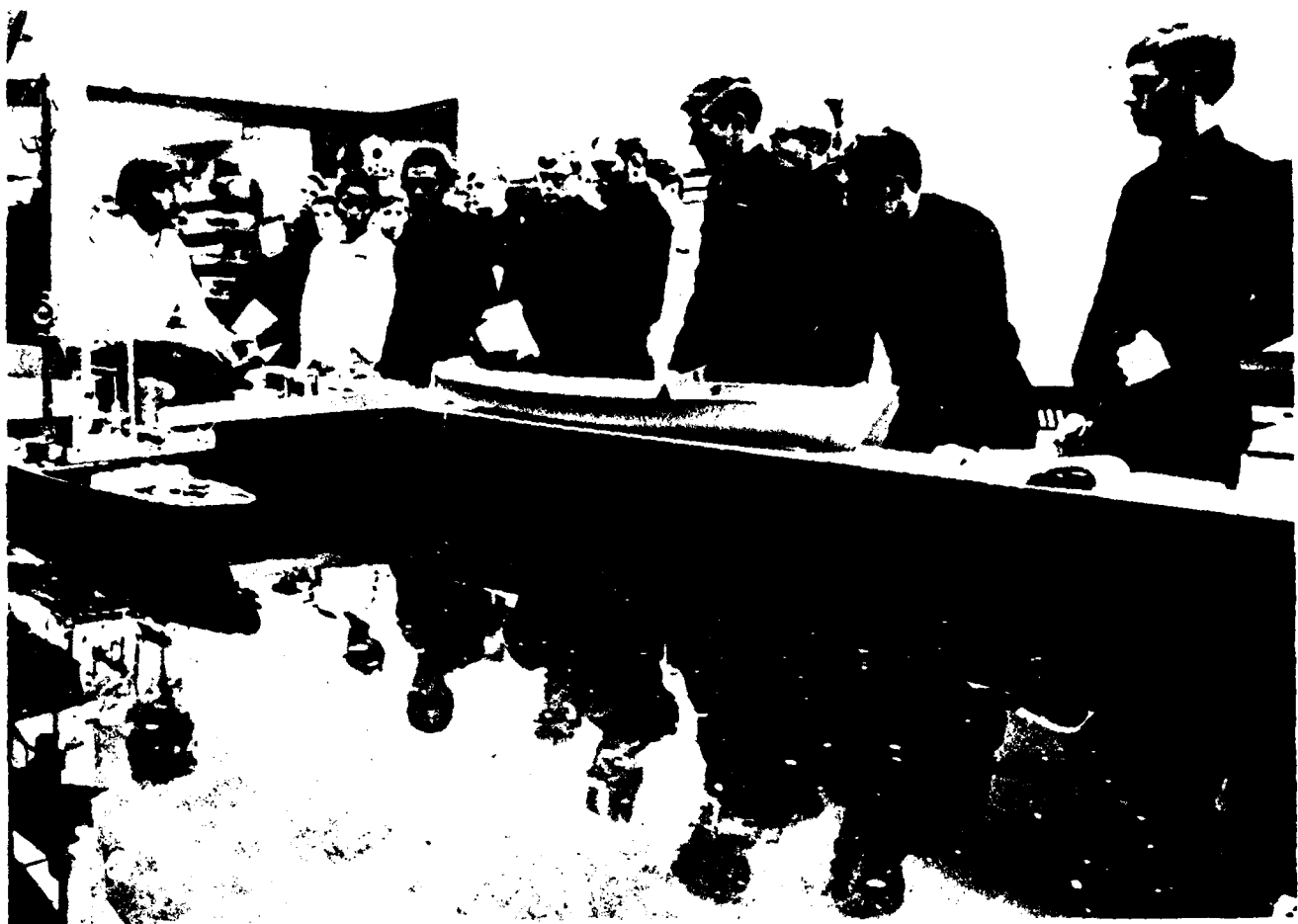
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DIVISION OF
ENGINEERING AND WEAPONS



AEROSPACE ENGINEERING DEPARTMENT

Commander Marle D. Hewett, USN, Chairman



The annual research summary for this Department reveals a deep interest by Department faculty over a very wide range of subjects. Nearly every member of the Department's ten-man faculty is involved in gaining knowledge on some frontier--from the thermodynamic cycle of a modified internal combustion engine to seeding effects on condensation of water vapor in aerodynamic nozzles. This intense research effort provides a rich atmosphere for learning and challenge. Consequently, faculty members are dynamic and up-to-date in their respective fields. As a result, the undergraduate instruction they provide is also up-to-date, interesting to the

student, dynamic, and relevant.

Midshipmen are very actively involved in the research efforts of the Department. Through the Trident Scholar Program and research course work, they explore limited portions of a faculty member's larger research effort or take on small independent study. Research adds spice to the teaching environment and rare excitement of discovery to those accepting the challenge.

Work continued on several major research efforts in the Department this year. The XR-5 Surface Effect Ship was completely refurbished and will be launched this summer. Sir Frank Whittle continued his work as an adjunct professor in boundary layer control. Research continued on the Naval Academy Heat Balanced Engine.

Several new research projects were initiated. Professor Jean Mayers of Stanford University, our Naval Air Systems Command Research Professor, initiated research in the structural properties of composite materials and shell buckling. Bensen aircraft donated a Bensen gyrocopter which will be used for research in rotor aerodynamics.

All in all, it has been an active and exciting year in Aerospace Engineering.

XR-5 TESTCRAFT OPERATIONS AND RELATED SES ANALYSIS

Researcher: Assistant Professor William J. Bagaria

Sponsor: Naval Sea Systems Command

The objective of this research was to refurbish the XR-5 Surface Effect Ship and to prepare plans for its utilization.

The refurbishment was completed in May 1979. The vehicle will be launched in June and undergo sea trials this summer. The data acquisition system is partially completed and will be utilized to expand the envelope of the ship to its full operating envelope by the end of this fiscal year.

Follow-on studies in out years will be concerned with providing performance and stability and control data throughout the ship's operating envelope, and testing new control and seal configurations.

DETERMINATION OF SUPERSONIC SKIN FRICTION COEFFICIENTS

Researcher: Professor Bernard H. Carson

Sponsor: Defense Nuclear Agency

Phase I of a dual-phase program was undertaken in this period, aimed at the determination of lateral and transverse skin-friction coefficients for typical surfaces corresponding to ablated heat-shield material. During this phase, a two-component wind tunnel balance was developed for use in the USNA 6" x 6" supersonic wind tunnel. Many unanticipated difficulties were revealed and resolved in experimental technique. Much of this information was of direct use to personnel at the Naval Surface Weapons Center who are performing parallel efforts in different flow regimes. Phase II, which will begin on 16 June 1979, will consist of actual measurements being performed with this developed equipment.

EXPERIMENTAL INVESTIGATION OF INITIAL BUCKLING AND COLLAPSE OF STIFFENED THIN CYLINDRICAL SHELLS

Researchers: Research Professor Jean Mayers and Assistant Professor William J. Bagaria

Sponsor: Naval Air Systems Command

Although the thin cylindrical shell in compression has been an extensively studied theoretical and experimental research problem for over sixty years, it still cannot be concluded that the initial buckling process is a purely elastic-deformation phenomena. Relatively recent kinematically and constitutively nonlinear analysis indicates that elasto-plastic material effects can be significant, the degree being dependent on both the magnitude of the effective radius-to-thickness ratio of the structure and the material of which the shell is fabricated. Unfortunately, in attempts to correlate experimental data with the classical or linear-theory predictions, published results for unstiffened shells omit any test data falling outside the linear-elastic material range. For stiffened shells, the structure of design interest, the experimental programs undertaken either classify as unreliable, too restricted in scope, or valid but devoid of sufficient information to use for correlation purposes (for example, the stress-strain curve of the material).

The fabrication and structural test facilities of the Naval Academy are being used to conduct an experimental program involving identical geometry ring- and stringer-stiffened shells representing four different flight-structure materials (two aluminums, one titanium, and a stainless steel). The stiffened cylinders consist of integral stringer-stiffened skins adhesively bonded to the rings. A special manufacturing process has been devised which uses the computer-controlled N/C mill to fabricate the integrally stiffened skins. The 200,000 pound hydraulic testing machine is currently being modified to test the cylinders and to automatically acquire and display the load vs. end-shortening curves. The tests are scheduled to be conducted during the summer of 1979.

POSTBUCKLING STIFFNESS OF ADVANCED COMPOSITE PLATES-- PREDICTION AND EXPERIMENT

Researchers: Research Professor Jean Mayers and Assistant Professor William J. Bagaria

Sponsor: Naval Air Systems Command

A common misconception concerning anisotropic advanced composite materials (for example, boron/epoxy and graphite/epoxy) is that, unlike isotropic conventional metals, they are characterized by mostly linear stress-strain relationships to failure. Recent theoretical study and computational analysis at Stanford University has established that non-linear material behavior of angle-ply boron/epoxy laminates significantly reduces the postbuckling stiffness of edge-supported thin plates in axial compression. The same phenomenon has been observed in tests conducted at General Dynamics with edge-stiffened plates fabricated of angle-ply graphite/epoxy. Such plate structure and compressive loading condition are found in the skin surface of aircraft (for example, F-14 stabilator with boron/epoxy and F-18 wings, fuselage, and empennage with a significant portion being graphite/epoxy). This surprising behavior of advanced composites could limit the freedom to arbitrarily tailor composite lay-ups to the extent desired for cost-effective weight-savings and maintain the conventional metals, such as aluminum, competitive as gains in specific strength and stiffness are achieved.

To establish the validity of the theoretical work and justify its use as an engineering tool, a series of experiments has been designed to buckle and postbuckle eight different plate lay-ups of angle-ply graphite/epoxy. The basic plates, fabricated at Grumman Aerospace, have adhesively bonded edge stiffeners added to provide proper boundary conditions along the unloaded edges; the loaded-edges are to be potted into specially designed and fabricated fixtures. Axial compression loading is to be provided by a hydraulic testing machine. Currently, a computerized data-acquisition system is being developed for the purpose of automatically recording and displaying the load versus end-shortening data, the information from which the postbuckling stiffness is derived. Tests are scheduled to take place in the summer of 1979.

NAVAL ACADEMY HEAT BALANCED ENGINE (NAHBE) PROJECT

Researchers: Professor Andrew A. Pouring, Assistant Professor Eugene L. Keating (Mechanical Engineering Department), Professor J. Alan Adams (Mechanical Engineering Department), Associate Professor Dennis Hasson (Mechanical Engineering Department), Professor Bruce Rankin (Naval Systems Engineering Department), Commander Charles Failla (Mechanical Engineering Department), and Midshipman I/C Steven Petri

Sponsor: Office of Naval Research

The following tasks were undertaken this year in connection with the continuing research on the Naval Academy Heat Balanced Engine:

1. Preliminary thermodynamic modeling of the heat-balanced cycle was completed and resulted in the development of an Air Standard Cycle. In the summer months, additional work will continue on this project. It is anticipated that the further efforts will result in the prediction of Fuel/Air Standard cycle calculations and the use of chemical thermophysical data to model more precisely the time-events which occur in the actual heat-balanced cycle. The additional thermodynamic modeling will contribute a more realistic prediction of the performance of heat-balanced internal combustion engines.
2. Using an existing computer program, the effect of increasing piston core temperature to 600°F and 700°F is being investigated.
3. The calculations are being repeated for common steel, stainless steel, and beryllium copper.
4. The effect of a stub-fin under the cap is being investigated.
5. The literature is being reviewed on ablation theory of reentry bodies to see how it applies to NAHBE processes.
6. Using the heat transfer study of Professor J. Alan Adams, the material properties of first, aluminum, then the other metals for the temperature ranges under study, are being investigated. Crystallographic reorientation, and the effects of heterogeneous combustion interaction on metallic surfaces are also being investigated, coordinating this study with the ablation theory review.
7. Using the glass engine (square version), the photographic investigation of schlieren and holographic methods is being completed. The effect of changing balancing volume, gap width and gap length, the metal surfaces of Adams, as well as nickel-plated (catalytic) surfaces, are being investigated.
8. The parametric study of the CFR engine is being completed.
9. The applicability of the Buckle Kinetic Cluster Theory as proposed in Transactions of the Faraday Society, 65, 1269 (1969) to the process of combustion in the heat-balanced cycle as described in USNA EW Report No. 8-76 is being investigated.

MODEL TESTING OF B-AL ICEBREAKER

Researcher: Professor David F. Rogers

Sponsor: U. S. Coast Guard

The objective of this project was to apply the CAD/CAM interactive graphics technique as implemented at the U. S. Naval Academy to the design of a new icebreaker hull.

The hull was faired, redesigned in the bow section, and an 89" towing tank model was completed.

The project was pursued in conjunction with the USNA Hydromechanics Laboratory. A second effort is presently underway for a Great Lakes Icebreaker for the U. S. Coast Guard.

SURFACE DEFINITION IMPROVEMENT

Researcher: Professor David F. Rogers

Sponsor: Naval Ship Engineering Center

The purpose of this task was to improve the accuracy, simplicity, and overall efficiency of hull-surface definition by investigating the most recent developments in mathematical surface definition as to their applicability to ship design. A pilot program was developed for the most promising definition scheme to demonstrate the degree of simplicity, accuracy, overall efficiency, and ease of use by the designer. A report was provided which included rationale for scheme selection, sample input, resulting output, and a discussion of range of applicability of this scheme.

BOUNDARY LAYER CONTROL

Researcher: Sir Frank Whittle

Sponsor: Naval Air Systems Command

The objective of this research is to investigate the feasibility of using boundary layer control to significantly increase range in cruise flight. Two methods are being investigated. First, single and double roller wings are being investigated. These use the "Magnus effect" to reduce drag and increase lift on wings of large thickness/chord ratio by employing spinning rollers located aft of the point of maximum thickness to increase circulation and accelerate the boundary layer. Successive

modification of this concept progressively increased lift and reduced wake momentum loss; however, it was found possible to obtain thrust. Best results were obtained with the roller elevated to .25" above wing profile and with the roller covered with a 'furry' textile. Unfortunately, it was not possible to measure roller power absorption.

Second, boundary layer blowing is being investigated to reduce wake momentum loss and increase the lift coefficient of wings of high thickness/chord ratio by using blowing slots to re-energize boundary layer and thus prevent flow breakaway.

Results: Variants of three wing models are being tested. The first wing has a thickness/chord ratio of 15.4%, and single blowing slot on the upper surface just aft of the point of maximum depth. The second wing has a thickness/chord ratio of 26.6% and three blowing slots: No. 1 on upper surface just aft of maximum depth, No. 2 on upper surface midway approximately between No. 1 and trailing edge, No. 3 on under surface near the trailing edge. The third wing has a thickness/chord ratio of 34% and three upper-surface slots; No. 1 just aft of maximum depth, and Nos. 2 and 3 approximately equally spaced between No. 1 and T.E. It was found possible to prevent flow breakaway up to angles of attack of 40° . In both latter wings, the No. 1 slot greatly improved C_L but was found unnecessary for drag reduction.

Experiments on the latter two wings are still in progress.



FREE-FEATHERING ROTOR

Researcher: Associate Professor Vadym V. Utgoff

The free-feathering rotor differs from a conventional fully-articulated rotor in that in the free-feathering rotor a flap angle is imposed but the blades are free to rotate about the pitch axis, whereas in the conventional rotor a pitch-angle is imposed but the blades are free to flap. Blade pitch in the free-feathering rotor depends on a balance of aerodynamic and centrifugal forces, just as the flap angle depends on this balance in a conventional rotor.

In general, analysis and tests are in fair agreement. In all operating modes, the thrust coefficient and coning angle are essentially linearly related if no part of the blade is stalled. In powered axial flow (vertical climb or rotor prop mode), the thrust coefficient decreases with increasing inflow ratio, but to a far lesser degree than in the case of a fixed pitch propeller.

In autorotative vertical descent the thrust coefficient and inflow ratio are substantially independent of rotational speed.

In an in-plane flow field (horizontal flight), the thrust coefficient is essentially independent of advance ratio. The rolling-moment coefficient is near zero for advance ratios up to about .5. Above .5 the rolling moment coefficient increases linearly with advance ratio.

KINEMATIC AND MECHANISMS DESIGN VIA COMPUTER GRAPHICS

Researcher: Midshipman 1/C David S. Andrews

Adviser: Professor J. Alan Adams (Mechanical Engineering Department)

This project involved designing a generalized set of programs (in BASIC) to be used to solve for the motion of various linkage systems and mechanisms. The major portion of these programs deal with planar motion.

Computer programs available in FORTRAN (rewritten in BASIC) were combined with programs developed to accomplish these results.

THE DESIGN OF LIFTING FOILS FOR HYSWAS--A HYBRID ADVANCED MARINE VEHICLE

Researchers: Midshipmen 1/C Dale E. Carson and James D. Cloyd

Adviser: Associate Professor Roger H. Compton (Naval Systems Engineering Department)

The design of a set of subcavitating hydrofoils for a novel hybrid naval vehicle called HYSWAS (HYdrofoil Small Waterplane Area Single Hull) was performed. Given lift-curve slope and span limits were imposed on the design from earlier studies completed at DTNSRDC. This project supported another midshipman project concerned with the towing tank testing of a DTNSRDC twelve-foot model of HYSWAS.

The resulting design for a nominal 2000 LT vehicle was of the airplane configuration with 75% of the lift being developed by the forward (main) foils. Vehicle speeds of 15 kts (takeoff), 25 kts (cruise), and 50 kts (maximum) were investigated. Hydrofoil lift was given to be 30% of the displacement at the higher speeds and 10% at takeoff. The foils employ trailing edge flaps for control. Near-surface effects and cavitation phenomena were considered in the design.

PNEUMATIC ROTOR DUCT

Researcher: Midshipman 1/C Randel D. Compton

Adviser: Associate Professor Vadym V. Utgoff

This is an experimental project to determine the improvement in rotor thrust which might be obtained with a pneumatic duct. A pneumatic duct-effect can be obtained by leading high pressure air to the tips of a rotor and discharging it through a peripheral slit in such a manner as to establish end plates of high velocity air.

A rotor consisting of two blades, fabricated by the Technical Support Department, capable of conducting air to the tips, and equipped with end plates designed to establish a peripheral slit, was tested in the Rotor Laboratory to determine the effects of various mass flows and exit velocities. Results were inconclusive.

POSTBUCKLING STUDY OF ADVANCED COMPOSITE PLATES

Researcher: Midshipman 1/C William K. Gray

Adviser: Research Professor Jean Mayers

In view of the continuing interest in ultimate widespread application of advanced composite materials to flight vehicle primary structure, a theoretical analysis was undertaken to predict compressive postbuckling stiffness (effective width) of a typical wing-skin element bounded on two opposite sides by ribs and on the other two sides by stiffeners. The effort was effected using linear-elastic material properties, nonlinear kinematics of deformation, and a modified version of Reissner's variational principle. The results, reduced to special cases, as appropriate, compared exactly with the classical result for an isotropic plate (aluminum, titanium, etc.) and to a negligible difference, with published results for an orthotropic plate (fiberglass). Results were then generated for N-layered, symmetric, angle-ply lay-ups of both graphite/epoxy and boron/epoxy, including orientations of $\pm\theta^\circ$, combinations of $\pm\theta^\circ$ and 0° , and $\theta = \text{all} + 45^\circ$. A minute computer-aided effort was required only to establish the effective physical constants of the variously laid-up, 20-layered laminates. The analysis can be used to compare either advanced composite materials directly or, for a given material, the combination of buckling load and postbuckling stiffness that maximizes the load carried by the plate at a specified value of unit end-shortening normalized with respect to the end-shortening at buckling.

SOLID-FUEL ROCKET MOTOR OPTIMIZATION

Researcher: Midshipman 1/C Michael A. Hecker

Adviser: Professor Andrew A. Pouring

Solid fuel/hybrid motor combinations were examined to determine optimum propulsion systems for small sounding rockets. A motor was designed, static fired, and flown in an appropriate design.

RESEARCH COURSE PROJECTS

AEROSPACE ENGINEERING DEPARTMENT

ANALYSIS OF THE MIDGET MUSTANG FUSELAGE

Researchers: Midshipmen 1/C Kevin L. Jackson and Daniel F. Lyons

Adviser: Assistant Professor William J. Bagaria

The USNA Aerospace Engineering Department will be using the fuselage of the Midget Mustang as a structural test article for EA323. The purpose of this project was to structurally analyze the fuselage. The areas of investigation were:

1. structural loads for ± 9 g's,
2. determination of first approximation analysis of fuselage stresses,
3. test fixture design, and
4. sizing of load application and measuring components (hydraulic cylinders, load cells, etc.).

The GIFTS structural analysis program was utilized to perform the structural analysis.

HOW WAVES AFFECT THE LIFTING CHARACTERISTICS OF A SUBMERGED BODY

Researcher: Midshipman 1/C Richard D. Lanning, Jr.

Advisers: Associate Professors Maido Saarlus and Roger H. Compton
(Naval Systems Engineering Department)

This project was designed to examine the conditions that our modern nuclear submarines are exposed to at periscope depth, conditions which are known to cause control problems. Near the surface a submarine tends to surface due to the venturi effect between the submarine and the surface.

A body of revolution was subjected to varying waves at periscope depths. Lift and moment were examined. The body was tested at different depths and speeds through the tow tank, with varying pitch and yaw angles. The results confirmed the existence of this difficult control region and determined the magnitude of the effect with various parameters.

ANALYSIS OF THE MARK-76 PRACTICE BOMB

Researcher: Midshipman 1/C John C. Pedigo

Adviser: Assistant Professor William J. Bagaria

The Pacific Missile Test Center (NASC) has issued a requirement that "all future MK-76 practice bombs must have virtually identical ballistic properties." The purpose of this project was to conduct a parametric study of the bomb's physical and aerodynamic characteristics. The areas of investigation included (1) measurable physical properties (size, weight, C.G., moments of inertia, center of pressure, etc.), (2) predictions of horizontal distance to ground impact, time of flight and length of trajectory, and (3) aerodynamic parameters affecting flight stability.

DESIGN OF A WATER-BASED GLIDER

Researcher: Midshipman 1/C Thomas P. Phelan

Adviser: Associate Professor Vadym V. Utgoff

The basic idea of this project was to design an amphibious sailplane based on some performance parameters. An attempt was made to obtain the optimum performance in each of the mediums concerned--air and water--and not just a compromise between the two.

Tests were conducted in the wind tunnel and tow tank to prove the calculations.

AIRFOIL BOUNDARY LAYER CONTROL BY ROTATING CYLINDERS

Researcher: Midshipman 1/C Dennis Reilly

Adviser: Professor Andrew A. Pouring

This was an experimental project designed to determine the effects of mechanically controlling airfoil circulation. A flow study of an airfoil with a single roller placed just behind the leading edge determined the optimum position of a second roller to be placed aft on the upper surface. Roller speed and angle of attack were varied, and the lift coefficient and lift-to-drag ratio were redetermined to find optimum performance.

RESEARCH COURSE PROJECTS

AEROSPACE ENGINEERING DEPARTMENT

HYPERMIXING COANDA AUGMENTOR

Researcher: Midshipman I/C Lawrence S. Rice

Adviser: Associate Professor Vadym V. Utgoff

This was an experimental project designed to determine the effects of hypermixing on the performance of a Coanda-type augmentor.

The augmentation ratio and exit velocity distribution of a Coanda-type augmentor were determined. A ring of vortex generators were then installed in the throat of the augmentor, and the augmentation ratio and exit velocity distribution were determined again. Size, aspect ratio, and angle of incidence of the vortex generators were varied and the operating parameters were redetermined, with a view to determining optimum performance.

DETERMINATION OF ENGINE PERFORMANCE DATA FOR THE WILLIAMS WR400 TURBOJET ENGINE WITH WATER INGESTION

Researchers: Midshipmen I/C Harvey T. Walsh and Brian D. Ward

Adviser: Professor Andrew A. Pouring

Water ingestion was added to the WR400 turbojet engine to determine (1) dry performance data without the bell housing in order to provide a data base, (2) dry performance data with the bell housing in order to determine its effect on performance, and (3) performance data with the bell housing and water ingestion at various rates.

With this data, a maximum rainfall rate for operation was derived.

PERFORMANCE CHARACTERISTICS OF NAHBE FUEL DELIVERY SYSTEMS

Researcher: Midshipman I/C T. J. Wasylkiw

Adviser: Professor Andrew A. Pouring

The purpose of this project was to test a NAHBE fueler for 2-stroke spark ignition engines using a 2-stroke motorcycle engine being converted by Midshipman Steven W. Petri, Class of 1978.

The testing included the following objectives: (a) Air/fuel variations and influence on performance, (b) Fuel variations with respect to optimum consumption and power output, and (c) Engine characteristics with regard to variations in load.

These were characterized by the following measurements: (a) Emissions, (b) P-V diagrams, (c) P-T diagrams, (d) Peak pressure, (e) Indicated and brake horsepower, and (f) Specific fuel consumption.



PUBLICATIONS

AEROSPACE ENGINEERING DEPARTMENT

POURING, Andrew A., Professor, Eugene L. KEATING, Assistant Professor (Mechanical Engineering Department), and Richard F. BLASER (Contractor), "Quasi-Equilibrium Air Standard Heat Balanced Cycle Analysis," Paper Number 789036, Proceedings of 13th Intersociety Energy Conversion Engineering Conference, August 1978.

The Air Standard model of the cycle for the Naval Academy Heat Balanced Engine (NAHBE) has been investigated analytically. The "ideal" thermodynamic or heat-balanced cycle was studied parametrically to determine the influence of changes in geometry and heat input on predicted indicated engine performance. Values for the cycle state points, as well as mean effective pressure and thermal efficiency, were obtained from the analysis as a function of variations in compression ratio and heat input. Comparisons are given with compatible Air Standard Otto and Diesel cycles. Results obtained for quasi-equilibrium indicate that for equal compression ratios and total heat input, the heat-balanced cycle yields lower peak pressures than the Otto cycle and with optimum geometry yields higher thermal efficiency than the Otto cycle. Equilibrium reduces to the classic dual cycle.

POURING, Andrew A., Professor, "Method and Apparatus for Production of Seeding Materials," U.S. Patent Number 4,129,252, 12 December 1978.

A method and apparatus are provided for production of ice nuclei by generation of homogeneous nuclei in nozzle or orifice expansions. The homogeneous nuclei are formed in the rapid cooling of vapors by rapid expansion through a supersonic nozzle or an orifice. These nuclei then serve as seeding materials for formation of ice.

A preferred method of carrying out the invention includes heating a volatile compound in a closed chamber to form a vapor, pressurizing the chamber with nitrogen gas and controllably releasing the resulting nitrogen gas-vapor combination through a nozzle or orifice in supersonic flow.

ROGERS, David F., Professor, Mathematical Elements for Computer Graphics, translated into Japanese, The Nikkon Kogyo Shimbrin, Ltd., Tokyo, Japan, April 1979.

This is an introduction to the mathematical bases for computer graphics. Building on the student's background in programming and mathematics, the book merges these to provide a fundamental understanding of the mathematical operations necessary for graphical definition and manipulation. These are sufficient for creating special purpose software for computer graphics applications. Representation of points, lines, and surfaces in three

dimensions is discussed. The techniques for producing orthographic, axonometric, and perspective drawings are unified under one mathematical technique. A useful technique for reconstructing 3-D information from perspective views (such as photographs), is presented for the first time in a text. Appendices contain computer programs illustrating implementation of theory. A course in college level algebra and calculus is a necessary prerequisite. Mathematics which are required in a computer graphics course are presented in the book.

SAARLAS, Maido, Associate Professor, Steam and Gas Turbines for Marine Propulsion, Annapolis: Naval Institute Press, 1978.

This book emphasizes principles, essential applications and performance rather than construction, hardware, and design variation. The three primary considerations of the author are the fundamentals and background for understanding the operations of steam and gas turbines, the relation of the turbine to the overall performance of a power-plant system, and a clear explanation of the performance potentials of steam and gas turbines. Theoretical and practical outlines are supported by illustrative examples, and references for the verification of specifications and further study are provided.



PRESENTATIONS

AEROSPACE ENGINEERING DEPARTMENT

POURING, Andrew A., Professor, Eugene L. KEATING, Assistant Professor, (Mechanical Engineering Department), and Richard F. BLASER (Contractor) "Quasi-Equilibrium Air Standard Heat Balanced Cycle Analysis," Paper Number 789036, 13th Intersociety Energy Conversion Engineering Conference, San Diego, California, August 1978.

ROGERS, David F., Professor, co-author, "A Microprocessor Display Controller for Combining Refresh and Storage Tube Graphics," SIGGRAPH '78, Fifth Annual Conference on Computer Graphics and Interactive Techniques, Atlanta, Georgia, 23-25 August 1978.

ROGERS, David F., Professor, co-author, "Computer-Aided Ship Design and Numerically Controlled Production of Towing Tank Models," 16th Design Automation Conference, San Diego, California, 25-27 June 1979.

SAARLAS, Mado, Associate Professor, co-author, "Application of Solar Energy to Dehydration of Onions," Solar Industrial Process Heat Conference, Denver, Colorado, 18-20 October 1979.

SAARLAS, Mado, Associate Professor, Martin E. NELSON, Associate Professor (Naval Systems Engineering Department), and Clyde C. RICHARD, Assistant Professor (Naval Systems Engineering Department), "Problems Encountered in Developing and Applying Data to Power Plant Reliability Models - A Consultant's Viewpoint," Sixth Annual Reliability Engineering Conference for the Electric Power Industry sponsored by IEEE, Miami, Florida, 16-19 April 1979.

UTGOFF, Vadym V., Associate Professor, "Free-Feathering Rotor," Fourth European Powered Rotorcraft and Powered Lift Aircraft Forum, Stresa, Italy, 11-16 September 1978.



ELECTRICAL ENGINEERING DEPARTMENT

Professor Francis Joseph Eberhardt, Chairman



The research interest of the students and faculty are still diversified but more and more digital techniques are utilized. Though such terms as acoustic signatures, waveform generation, side-band modulation, and predictive filtering abound, the common denominator has become the use of digital networks from small special-purpose logic combinations to 16-bit microprocessors of great speed and flexibility. One of the advantages of work in the microprocessor area is that almost everything learned or developed in hardware and software has a direct carry-over into developing course work in logic design, in instrumentation, and in communication

theory. This growth in use of digital based concepts is expected to continue.

There is also a renewed interest in educational research and the Department is involved in a large-scale project for instructional development using computer-managed, video-assisted drill and remedial programs. These are being designed as self-help aids for students in basic areas of electrical engineering. The regeneration of interest in this area comes because of advances in technology which have made graphics, fast-output, and control of video all compatible and interactive. This has added a new dimension to any kind of computer assisted learning process.

Research in the Department of Electrical Engineering serves three purposes: it supports continuing development of the faculty; it provides the important element of applied engineering for midshipmen who participate in projects; and it contributes new knowledge to the disciplines. The second of these purposes is the most important at the Naval Academy. Research must provide the basis for a strong undergraduate program. Therefore, in addition to advancing the frontiers of their research areas, faculty members are committed to maintaining dynamic and challenging projects for midshipmen who choose to specialize in electrical engineering. Participating midshipmen have the opportunity to engage, with faculty, in unstructured scientific efforts of a wide variety. Thus, they are exposed to some of the techniques applied to the solution of practical engineering problems. Research activity provides midshipmen the opportunity to learn how the engineering community responds to the ever-expanding needs of the service.

SPONSORED RESEARCH

ELECTRICAL ENGINEERING DEPARTMENT

TESTING OF MICROPROCESSORS FOR PREDICTION OF PERFORMANCE UNDER RADIATION

Researcher: Associate Professor Richard L. Martin

Sponsor: Naval Research Laboratory

Characterization studies were performed on a total of 23 8080A microprocessors obtained from two different vendors. The microprocessors were characterized in terms of supply current, propagation delays and clock thresholds.

Four of the microprocessors were irradiated with ionizing radiation, and their characteristics were remeasured at appropriate levels of radiation dosage. Ultimate failure-levels were noted along with general correlations of the changes in various characteristics as a function of radiation.

A LITERATURE STUDY OF DIGITAL SPEECH PROCESSING FOR MAN-MACHINE COMMUNICATION BY VOICE

Researcher: Professor Ralph P. Santoro

Sponsor: Naval Electronics Systems Command

This is the beginning of a continuing effort in the application of microcomputers to the area of man-machine communication by voice. This area is just developing and is destined to become of great importance in the future.

The effort of this research is primarily a literature survey to increase knowledge of the digital speech-processing discipline in the areas of theoretical approaches and applications. It will result in the definition of an area of application for which the TI-9900 based signal-processing microcomputer can be applied.

DEVELOPMENT OF A CONTROLLER FOR THE CAVE SYSTEM

Researcher: Professor Ralph P. Santoro

Sponsor: Academic Dean (Instructional Development Program)

A microprocessor-based controller for the SONY VP-2000 video-tape player has been developed. This controller enables the Academic Computing Center to operate a VP-2000 cassette player located at any of the remote

SPONSORED RESEARCH

ELECTRICAL ENGINEERING DEPARTMENT

computer terminals within the yard; four commands--STOP, PLAY TO COUNTER NUMBER, GO TO COUNTER NUMBER, and PAUSE--permit the main computer to remotely initiate and terminate all the Sony tape-player functions.

The controller enhances the CAVE system by allowing:

1. More sophisticated branching between computer and video.
2. More personalized video presentations in accordance with student needs.

NONINVASIVE DETERMINATION OF THE SEVERITY OF AORTIC STENOSIS

Researcher: Associate Professor Antal A. Sarkady

Sponsor: Children's Hospital, National Medical Center, Washington, D.C.

This is a joint research project between Children's Hospital, National Medical Center, Washington, D.C., and the U.S. Naval Academy. The objective is to develop a safe, noninvasive method of assessing the severity of congenital aortic stenosis in children by utilizing computer analysis of phonocardiograms.

The phonocardiogram data are recorded on magnetic tapes during cardiac catheterization at Children's Hospital and analyzed on the USNA TSS computer system. The first spectral movement (\bar{S}) of the averaged power-spectrum of a quasi-stationary segment of the aortic murmur is correlated with the peak systolic pressure gradient and the aortic valve area. The research will be meaningful if significant correlation between (\bar{S}) and the aortic valve-gradient can be established, thus providing an estimation of the gradient in patients with aortic stenosis, without the need for cardiac catheterization. Currently the phonocardiogram data analysis of sixteen recorded patients is in progress.

DESIGN AND DEVELOPMENT OF A LOW COST VERSATILE MICROCOMPUTER-BASED PULSE-HEIGHT ANALYZER

Researchers: Associate Professor Antal A. Sarkady and Associate Professor Errol E. Wallingford

Sponsor: David W. Taylor Naval Ship Research and Development Center

The objective of this project was to design and develop a portable microcomputer-based pulse-height analyzer which can be used to compute the probability density-function of shipboard acoustical sensor-signals.

The instrument is designed around the TI9900 microprocessor. The instrument is designed around an inexpensive commercially available 16-bit microcomputer which requires only added I/O and programs. The computer performs a multifunction role of data acquisition, data acquisition timing, data processing, and control of the display of a pulse-height spectrum. The spectrum is refreshed continuously by a foreground display program which is interrupted for each pulse-height data acquisition. The incoming data at maximum rate of 20KHz is digitized to one of 256 different amplitude levels and is used to update the display counts. Pulse-height display scale from 256 to 65,536 counts in powers of two are continuously available to the operator via user controlled switches. The microcomputer checks the status of these switches after each frame-scan of display and scales the output data amplitudes accordingly. Data acquisition time durations in the range of 10 ms. to 8 hours is provided by a software controlled programmable interval timer. The microprocessor is readily available to perform other more sophisticated signal processing applications such as feature extraction, pattern identification, correlation or data smoothing.

This instrument is presently being used at DTNSRDC in flow noise measurements.

THE SP16 FAST FOURIER TRANSFORM SIGNAL PROCESSOR

Researchers: Associate Professor Antal A. Sarkady and Associate Professor Errol E. Wallingford

Sponsor: David W. Taylor Naval Ship Research and Development Center

A versatile low-cost two-channel signal processor was developed using the Texas Instruments TM 990/100M microcomputer board and a special purpose I/O and memory expansion board. The development includes both hardware and firmware implementation.

In near realtime and online, analysis of two signals is performed in the frequency and time domains. Estimates as well as ensemble-averaged functions are computed in these domains. These include power and cross spectra, autocorrelation and cross-correlation functions, Hilbert transform, the analytic signal, cepstrum, and several other functions. Versatility, speed, and programming efficiency are obtained by the extensive use of analysis look-up tables. These tables reside in the RAM, and analysis branches are created by entering a sequence of ASCII characters into these tables. Each character references a sub-routine (F for fast Fourier transform, O for escape, etc.) and a large number of analysis branches can be created by the various permutations of characters.

Currently, the application of the SP16 signal processor to ship-board machinery performance monitoring is being explored.

THE ELECTRICAL SWITCHING PROPERTIES OF AMORPHOUS BISMUTH TRIOXIDE THIN FILM DEVICES

Researcher: Midshipman 1/C Robert S. Weis

Adviser: Professor Ralph P. Santoro

Sponsor: Trident Scholar Program

Amorphous semiconductors are being used in an increasing number of practical applications. These include photocopying (by Xerox), silverless photography, a new type of microfiche and even a few computer memories.

The initial goal was to develop a computer memory using a relatively new amorphous semiconductor--bismuth trioxide. Because little had been published about this material, the development of a reliable memory required that its switching properties be thoroughly studied and characterized.

Two switching behaviors have been observed in all amorphous semiconductors: threshold switching and memory switching. Memory switching is a steady state phenomenon while threshold switching, the first step in the memory switching process, is a transient phenomenon.

Because of time constraints, efforts were concentrated on the threshold switching properties of amorphous bismuth trioxide thin films. Each film was on the order of one-hundredth of a human hair thick. It was found that threshold switching in these films could not be explained by a process that is exclusively electronic or thermal but rather appears to include them both in an electrothermal mechanism. This information was not previously known and is an important contribution to the body of knowledge that is necessary to the development of a reliable computer memory.

TWO N-POINT FAST WALSH TRANSFORM ALGORITHM

Researchers: Associate Professor Errol E. Wallingford and
Lieutenant Commander James C. Culpepper, USN

Two N-Point Fast Walsh Transform (FWT) algorithms are examined and compared with an FFT algorithm. The transform portion of the Walsh algorithm is much simpler than the FFT since it requires only addition and subtraction and the processing of real data. The sorting problem, however, is more difficult than the simple bit reverse coding algorithm of the FFT.

This has resulted in the implementation of two different sorting algorithms: a simple one which generates a locating sequence then uses it to do an out-of-place sort, and a second one which uses the in-place bit reverse coding algorithm, as the first step only, followed by extensive in-place sorting for large N. The out-of-place output sort N-point FWT is approximately three times as fast, and the in-place FWT is approximately twice as fast for N=1024 as a similar FFT.

The choice between the two algorithms is further complicated since the sort routines produce different orderings of the sequency coefficients. The out-of-place output sort sequency coefficients are monotonically increasing WALS, whereas the in-place sort produces monotonically increasing SALS followed by monotonically decreasing CALS.

Implementations in BASIC of the two FWT algorithms and an equivalent FFT algorithm are included. Direct transforms and Direct followed by Inverse transforms of all three algorithms using a ramp input signal are made for comparison purposes.

For this particular input, the FWT output is considerably simpler than that of the FFT. When the Inverse is taken, the original ramp is perfectly reconstructed using either FWT algorithm. Perfect reconstruction of the original ramp is not obtained using the FFT.

A MICROPROCESSOR CONTROLLED SCALE MODEL OF AN INDUSTRIAL WINDING PROCESS

Researchers: Cadets Greenwood and Picket (Royal Military College of Canada)

Adviser: Associate Professor Charles A. Fowler III

The object of this project was to model a winding process (such as a paper roll), and devise a microprocessor/control system. The proposed system was constructed; the parameters of components (moment of inertia, damping, resistance, etc.) were determined and the apparatus was assembled. The theoretical part of the microprocessor control was completed and approximately half the programming was completed.

MICROCOMPUTER-AIDED DESIGN OF FILTERS

Researcher: Midshipman 2/C Richard A. Medley

Adviser: Assistant Professor Tian S. Lim

Single-terminated filter design aided by microcomputer is investigated. The method is based upon a useful property of filter transfer function and the chain parameters. This property relates the even part of a filter transfer function to $A(s)$ of the chain parameters and the odd part to $B(s)$. Using simple formulas and algorithm implemented by microcomputer program, filter design can be effected with ease and with little expenditure of time.

A MICROCOMPUTER BASED VOICE SPECTRUM ANALYZER

Researcher: Midshipman 1/C John A. Ford

Adviser: Associate Professor Antal A. Sarkady

A TI9900-based voice spectrum analyzer was designed and developed during this project. The spectrum of a voice signal as a function of time is computed and is displayed on an XYZ oscilloscope by the computer.

The 128-point discrete Fourier transform is computed every 100 msec using the FFT algorithm. The spectrum is displayed using a log compression on a 16 gray scale.

The analyzer was used to study the voice spectrum of spoken words and can be used as a training tool for voice synthesis.

BURNS, Stephen H., Associate Professor, "The Absorption of Sound by Pine Trees," Journal of the Acoustical Society of America, 63 (March 1979), 658-661.

This paper describes a study of the absorption of sound by pine trees. Swept frequency measurements were made with small boughs in a reverberant box. Tests for branch and needle resonances were also made. The observed absorption is comparable to the expected thermoviscous absorption in the boundary layer of air that surrounds the individual needles.

DUNBAR, Peter M., Assistant Professor, "Higher Education and Technical Professionalism at the Undergraduate Level," IEEE Proceedings, 66 (August 1978), 868.

Educational institutions have been greatly influenced by expanding pressures to develop occupation-oriented undergraduate programs. These programs can be in serious conflict with the goals of institutions of higher learning. This paper discusses these conflicts with particular emphasis upon engineering education. It is concluded in this work that engineering programs fall far short of their responsibility to higher learning. Further conclusions state that one may no longer be able to define the Twentieth Century university in simple classical terms. Various recommendations reflecting these conclusions are presented. Emphasis is placed on the need to establish an intellectual base for the engineering discipline so that it may be properly included among the disciplines represented in undergraduate schools. Such a definition will require that practitioner-oriented material be separated into programs which can be readily identified. These programs should be visibly separate from general undergraduate education so that those entering, funding, and controlling the educational process have a clear perspective of the general attitude they must assume. In short, the university must in some fashion reassert itself as a nonprofessional entity if it is to maintain the role of a center for higher learning.

SARKADY, Antal A., Associate Professor, WALLINGFORD, Errol E., Associate Professor, and NEUSTADT, Herbert M., Associate Professor, "A Versatile Low-Cost Online Signal Processor Based on a 16-Bit Microcomputer," Conference on Industrial and Control Applications of Microcomputers (IECI) Proceedings (March 1979), 260-264.

A versatile low-cost two-channel signal processor was developed using the Texas Instruments TM 990/100M microcomputer board and a special purpose I/O and memory-expansion board. The development includes both hardware and firmware implementation.

In near realtime and online, analysis of two signals is performed in the frequency and time domains. Estimates as well as ensemble-averaged functions are computed in these domains. These include power and cross spectra, autocorrelation and cross-correlation functions, Hilbert transform, the analytic signal, cepstrum and several other functions. Versatility, speed and programming efficiency are obtained by the extensive use of analysis look-up tables. These tables reside in the RAM, and analysis branches are created by entering a sequence of ASCII characters into these tables. Each character references a sub-routine (F for fast Fourier transform, O for escape, etc.) and a large number of analysis branches can be created by the various permutations of characters.

Two simultaneously acquired time-series records are analyzed to form a pair of estimates. The record analysis is specified by a look-up table for channels 1 and 2 (RAT1 and RAT2). The pair of estimates are merged and summed or kept separately and summed into an average buffer according to a user definable directive (merge directive). The number of estimates averaged (i.e., the number of times the analysis is repeated) is defined by the user and determined by the confidence-interval required. When the averaging is completed, the average function or functions are saved and an additional analysis is performed according to look-up tables (EAT1 and EAT2). The results of the last analysis are plotted on an X-Y recorder.

Record length and sampling rate are user-selectable; the maximum values are 256 points and 40KHz respectively.

The system is implemented with 2K bytes of EPROM and 12K bytes of RAM at a total parts cost of approximately \$1100.

WALLINGFORD, Erröl E., Associate Professor, SARKADY, Antal A., Associate Professor, and NEUSTADT, Herbert M., Associate Professor, "A Fixed Point Fast Fourier Transform for a 16-Bit Microcomputer," IECI Conference Proceedings (March 1979), 256-259.

An FFT suitable for a general purpose, inexpensive, portable signal-processing unit was required. An N-point complex, radix-two, decimation-in-time FFT was chosen to process an expected large variety of signal sources. For fast operation, fixed rather than floating-point arithmetic was used. A TI9900 16-bit microcomputer was chosen for its powerful instruction set and its fast internal multiply. Six non-trivial problems arise in writing an algorithm in assembly language using 16-bit fixed-point arithmetic on a microcomputer: multiplying complex signed-numbers with a multiply instruction set for real unsigned numbers, the scaling problem due to the possible doubling of the numbers during each butterfly, the desirability of minimizing round-off error when

scaling, the necessity for evaluating the twiddle or rotation factors, the requirement to handle separately the real and imaginary data input, and the requirement to use double rather than single indexing for the 16-bit or 2-byte data words. How these requirements were met individually and how they were combined into a general algorithm is the main theme of this paper.

The complete FFT algorithm with all subroutines requires 280_{10} 16-bit words of EROM. The algorithm performs a complex 256 point FFT in 736 ms.

WEIS, Robert S., Midshipman 1/C, "The Electrical Switching Properties of Amorphous Bismuth Trioxide Thin Film Devices," Trident Scholar Project Report Number 101, (1979), U. S. Naval Academy, Nimitz Library, Annapolis.

Amorphous semiconductors are being used in an increasing number of practical applications, including computer memories and the development of a reliable memory requires that its switching properties be thoroughly studied and characterized. Two switching behaviors have been observed in all amorphous semiconductors; threshold switching and memory switching. Memory switching is a steady state phenomenon while threshold switching, the first step in the memory switching process, is a transient phenomenon.

Efforts were concentrated on the threshold switching properties of amorphous bismuth trioxide thin films. Each film was on the order of one-hundredth of a human hair thick. It was found that threshold switching in these films could not be explained by a process that is exclusively electronic or thermal but rather appears to include them both in an electrothermal mechanism. This information is an important contribution to the body of knowledge that is necessary to the development of a reliable computer memory.



PRESENTATIONS

ELECTRICAL ENGINEERING DEPARTMENT

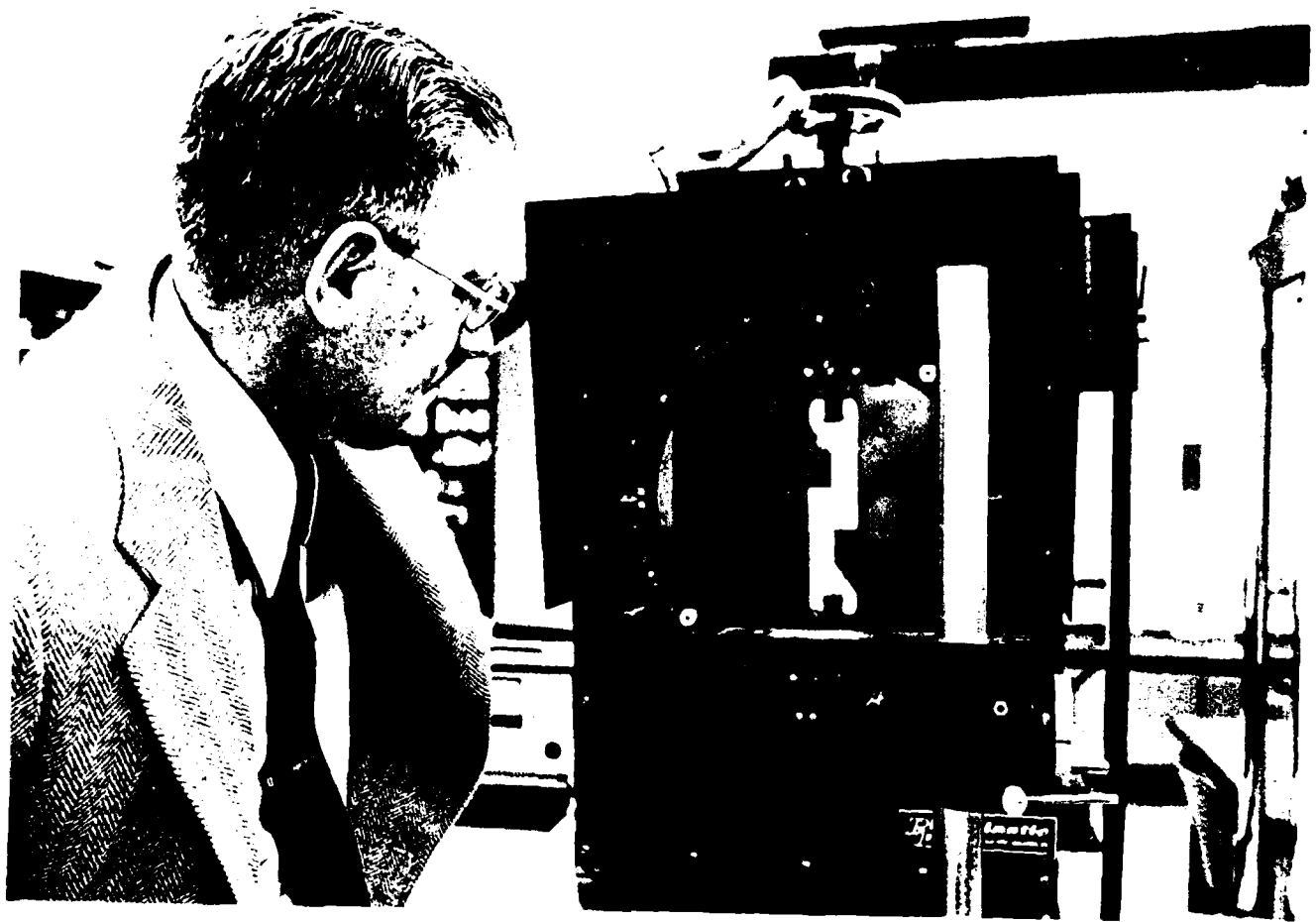
LIM, Tian S., Assistant Professor, "Optimal Synthesis of a Cascaded Ladder Network Using Chain Parameters," IEEE Mid-west Symposium on Circuits and Systems, Philadelphia, Pennsylvania, 17-19 June 1979.

NEUSTADT, Herbert M., Associate Professor, "An Introduction to Digital and Commutating Filters," USNA Electrical Engineering Seminar, Annapolis, Maryland, 12 September 1978.

SANTORO, Ralph P., Professor, "Microprocessors: Architectures and Applications," Chesapeake Section American Association of Physics Teachers, Columbia, Maryland, 21 April 1979.

SARKADY, Antal A., Associate Professor, WALLINGFORD, Errol E., Associate Professor and, NEUSTADT, Herbert M., Associate Professor, "A Versatile Low Cost On-Line Signal Processor Based on a 16-Bit Microprocessor," IEEE Conference on Industrial and Control Applications of Microcomputers, Philadelphia, Pennsylvania, 19-21 March 1979.

SARKADY, Antal A., Associate Professor, WALLINGFORD, Errol E., Associate Professor, and NEUSTADT, Herbert M., Associate Professor, "A Fixed Point Fast-Fourier Transform for a 16-Bit Microcomputer," IEEE Conference on Industrial and Control Applications of Microcomputers, Philadelphia, Pennsylvania, 19-21 March 1979.



MECHANICAL ENGINEERING DEPARTMENT

Professor Vincent J. Lopardo, Chairman



Faculty and midshipmen research in the Mechanical Engineering Department covers many of the areas of specialization in mechanical engineering. These include research in direct energy conversion, fluid mechanics, heat transfer, acoustics, dynamic effects, stress corrosion cracking, fracture mechanics, welding technology, design, and computer-aided graphics.

Research is supported through funds from six different government agencies with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, providing opportunities for several faculty members to work on projects during the intersessional period. Additionally, some faculty members have undertaken independent research in their areas of expertise. Including all levels of research, 14 civilian and two military faculty members have been active in the research of the Department this year.

An important part of the Department's research effort during the year has been the involvement of midshipmen in independent research, design, and development projects. Current midshipmen interests include the Naval Academy Heat Balanced Engine, computer graphics, and many aspects of fluid mechanics.

Supporting the research effort in mechanical engineering are the sophisticated laboratory facilities located in the Rickover Hall complex. The Department maintains facilities for performing experimental research in several areas: fluid mechanics, solid mechanics, materials science, experimental-stress analysis, control systems, mechanical vibrations, heat transfer, and thermodynamics.

The primary driving force behind the Department's research is the real need for the faculty to stay abreast of technological developments in the many diversified areas of mechanical engineering, thereby enabling them to be more effective classroom teachers.

SPONSORED RESEARCH

MECHANICAL ENGINEERING DEPARTMENT

NAHBE PISTON COOLING

Researcher: Professor J. Alan Adams

Sponsor: Office of Naval Research (Code 483)

Computer simulation of heat transfer behavior was used to investigate various cooling schemes for the Naval Academy Heat Balanced Engine (NAHBE) piston cap. The effect of possible cooling by thermal convection and radiation to a cold cylinder wall was studied, as well as the effect of using various materials for construction of the fin cap. Results showed that radiation cooling was not effective, but proper choice of materials could significantly assist the cooling problem. This analysis should be helpful in future designs of the NAHBE piston for use in the experimental program.

DETERMINATION OF CORRECTIONS TO RESIDUAL STRESS MEASUREMENTS IN REGIONS OF LARGE STRESS GRADIENTS

Researcher: Professor Thomas W. Butler

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

The accurate determination of residual stresses in the vicinity of welds is of major importance in determining the suitability of various welding processes. Large stress gradients exist in the vicinity of welds; consequently, normal residual stress measurements do not give reliable results. This investigation modified prior theoretical elasticity results to adapt them to certain geometric conditions experienced in welding research.

SUBMARINE MAIN SHAFT SEALS - SHOCK TESTING

Researcher: Associate Professor Elliott E. Dodson

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

Objectives of this work were to investigate prior shock analyses, and tests and design specifications for submarine propeller shaft seal systems; to study deep submergence submarine shaft seal designs for shock resistance capability; and to investigate the establishment of

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MECHANICAL ENGINEERING DEPARTMENT

new shaft seal system design specifications based on best available information and the establishment of guidelines to prove conformance to shock resistance requirements.

The design of the submarine and its components to meet the exigencies of combat situations, long a difficult problem, becomes more complex under considerations of increased operating depth capability.

Adequate shock design requirements and proof of conformance assume major significance.

NAHBE PARAMETRIC TESTING

Researcher: Lieutenant Commander Charles C. Failla, USNR

Sponsor: Office of Naval Research (Code 483) and Naval Material Command (Code 03Z)

Parametric testing of the Naval Academy Heat Balanced Engine (NAHBE) pressure exchange cap was performed using a Co-operative Fuel Research (CFR) test-bed. The engine was mapped in both standard and NAHBE configurations. Optimum parameters of edge-gap clearance and Beta (volume below the cap divided by volume above the cap at top dead-center) were identified. Subsequent optimization tests suggest a 20% increase in power output, a similar reduction in specific fuel consumption and a significantly cleaner exhaust emission.

NAHBE PISTON DESIGN AND MATERIAL TESTS

Researcher: Lieutenant Commander Charles C. Failla, USNR

Sponsor: Office of Naval Research (Code 483) and Naval Material Command (Code 03Z)

A Briggs and Stratton 8-horsepower tractor engine was used to examine heat transfer associated with the Naval Academy Heat Balanced Engine (NAHBE) pressure exchange cap. Three materials--extruded aluminum, cast aluminum and titanium--were tested under maximum operating stress conditions. A working design utilizing a combination of aluminum and titanium was developed and is currently undergoing tests.

DESIGN OF EXPERIMENTS FOR PROJECT LINEAR CHAIR

Researchers: Associate Professor John O. Geremia and Professor Chih Wu

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

A review of the entire research program was undertaken in order to evaluate the experimental part of this program. The objective of the analysis was to propose better ways to evaluate problem parameters. This was accomplished. Model tests were reduced from several hundred runs to as few as 30 runs, with more reliable information being obtained. The project is still in process and future work will concentrate on experiment design for full scale tests.

INVESTIGATION OF VORTEX-CONTROL FIN INTERACTIONS

Researcher: Assistant Professor Joseph D. Gillerlain, Jr.

Sponsor: Naval Surface Weapons Center, White Oak Laboratory and Naval
Air Systems Command

The objective of this investigation is to develop predictive methods for the aerodynamic behavior of missiles and aircraft experiencing vortex impingement on control surfaces. Accurate prediction of such phenomena becomes essential as maneuvering requirements become more severe, requiring flying at larger angles-of-attack. Detailed knowledge of the three-dimensional viscous flow field, as determined from wind tunnel experiments, is required in order to model the vortex-fin interaction and to develop predictive methods. Comparisons with existing potential methods will be made.

The experimental measurements will be made in the U.S. Naval Academy Aerodynamics Laboratory subsonic wind tunnel. A pressure-distribution model consisting of a rectangular fin with a cylindrical leading edge will be built. Non-intrusive flow-measurement and flow-visualization techniques will be used, to include laser anemometry and the fluorescent mini-tuft method, respectively. A three-dimensional laser Doppler velocimeter (LDV) will be used to survey the vortex-fin interaction flow field. The pressure-distribution data will be integrated to obtain aerodynamic forces, which will be compared with force-balance data. Conventional methods of wing/fin analysis will be used to predict the aerodynamic loads on the fin induced by the vortex. These analytical results will be compared to the actual measured loads determined from force balance and pressure distribution data. The various predictive methods will be compared.

Preliminary tests have been completed for vortex impingement on a rectangular fin. Data were obtained for a single vortex strength at ten upstream locations for five fin angles-of-attack. Pressure distributions on the fin were obtained, along with drag force, side force, and rolling moment measurements. Followup flow visualization tests are scheduled. In future experiments, the LDV will be used to survey the complete vortex-fin interaction flow-field in the fin region. It is expected that the data will be presented to show changes in aerodynamic force and moment coefficients as functions of vortex strength, vortex location, and control fin angle-of-attack. Resultant modeling of the vortex-fin interaction will contribute to the development of predictive methods for the aerodynamic behavior of missiles and aircraft experiencing vortex impingement on control surfaces.

CAUSES OF HOT-CRACKING THROUGH THE AGGREGATE MATRIX IN INCONEL CASTINGS

Researchers: Associate Professor Dennis F. Hasson and Ensign Russell Dedrickson, USN

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The objective of this research is to obtain an understanding of the cause of micro-cracks that form in weld-repaired castings of naval materials. The micro-cracks are more prevalent in materials with higher concentrations of residual silicon and/or iron. The sponsor requires optical and electron microscope micrographs and crack-tip chemical element distribution.

In order to examine the micro-crack morphology and the adjacent area chemistry a scanning electron microscope (SEM) with a microchemical analysis capability is required. SEM's with wave dispersive x-ray (WDX) analyzer and energy dispersive x-ray analyzer (EDAX) are to be utilized for the chemical analysis. The EDAX capability was arranged with the University of Maryland, College Park. These apparatus are employed to provide elemental analysis scans near the crack-tip and to determine if elemental segregation or depletion is occurring at the crack-tip. Optical metallography is also employed to determine the overall micro-structure.

Optical micrographs, SEM micrographs, WDX element scans and EDAX element scans have been provided to satisfy the requirements of the sponsor.

INVESTIGATION OF FRACTURE PHENOMENA IN WELDS

Researcher: Associate Professor Dennis F. Hasson

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

The objective of the study is to conduct laboratory investigations of fracture phenomena in two-and four-inch thick titanium weldments. Additional efforts will include the evaluation of mechanical properties and microstructures of base plate, weld and heat-affected-zone (HAZ) of out-of-position weldments produced by the gas-metal-arc (GMA) spray and pulsed-current welding modes.

Scanning electron microscope (SEM) fractography will be performed on fracture surfaces from mechanical tests. Stereomicrograph pairs will be taken to provide information for the determination of the model of fracture (e.g. ductile or brittle). Metallography will also be performed to assist in the interpretation of the fractographic morphology.

Major and interstitial chemical-element analyses, dynamic tear-tests, weldability tests, mechanical properties tests and fracture toughness test (e.g. Charpy V notch and J_{Ic}) will also be performed to evaluate the effects of welding process and variables on the integrity of welds.

The weldments are currently being fabricated. Mechanical and fracture tests will be performed this spring. Fractography will follow after the testing. Reports on this program will be in preparation during the summer intersessional period.

MATERIALS ANALYSIS FOR ALLOY SELECTION FOR THE NAHBE PRESSURE EXCHANGE CAP

Researcher: Associate Professor Dennis F. Hasson

Sponsor: Office of Naval Research (Code 483)

The pressure exchange cap is a key element in the Naval Academy Heat Balanced Engine (NAHBE) concept. During the development of NAHBE hardware on an air-cooled single cylinder engine, some evaporation/erosion of the cap occurred. In order to avoid this difficulty, a materials analysis was initiated to determine suitable metallic alloys. The analysis consisted of a metallographic and scanning electron microscope fractographic investigation of cast and extruded aluminum material caps from design testing programs on an air-cooled engine, and a materials selection study of several metallic alloys and a ceramic coating. Cast aluminum or non-heat treatable 5000 series aluminum and titanium alloys in the form of plate were proposed for the cap material. Studies of welding of the 5000-series aluminum and titanium materials to cast aluminum, and fuel/material compatibility with blended fuels were proposed.

SPONSORED RESEARCH

MECHANICAL ENGINEERING DEPARTMENT

FATIGUE CHARACTERISTICS OF ANODIZED ALUMINUM IN A SALT WATER ATMOSPHERE

Researchers: Associate Professor Dennis F. Hasson and Assistant
Professor James A. Joyce

Sponsor: Naval Surface Weapons Center, White Oak Laboratory

The objective of the research is to obtain information leading to an understanding of the fatigue characteristics of anodized aluminum.

The specimens will be tested in fatigue in either dry or moist salt air. The cycles to failure at various stress-levels will be determined. The specimen fractures will be examined in the scanning electron microscope to determine the behavior of the anodized film and any degradation in its protective characteristics.

Preliminary analysis of the test apparatus has been performed. Testing should commence in the summer intersessional period.

STRESS-CORROSION-CRACKING BEHAVIOR OF DEPLETED URANIUM ALLOYS

Researchers: Associate Professor Dennis F. Hasson and Assistant
Professor James A. Joyce

Sponsor: Naval Surface Weapons Center, White Oak Laboratory

The Navy is interested in high strength and density alloys, such as depleted uranium for an advanced system. Studies of the mechanical properties and fracture toughness of U-M_o, U-Ti and U-Quint alloys in dry air proved satisfactory. Investigation of the same properties, however, is required in moist salt air.

Tensile, Charpy V-notch toughness and cantilever beam stress-corrosion-cracking stress intensity (K_{ISCC}) tests were performed. Supporting metallographic and scanning electron microscopy were also performed.

All alloys have been tested and the results analyzed. Four reports are ready for submission for journal publication.

FRACTURE INSTABILITY OF STRUCTURAL MEMBERS

Researcher: Assistant Professor James A. Joyce

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

This work is directed toward evaluating the validity of the J_{IC} -R curve "Tearing Modulus" concept of predicting structural instability in elastic-plastic structures. To accomplish this, a large spring apparatus has been constructed to act as a structure with large stored elastic energy. This apparatus will be used to check predictions of the stability of flaws in compact specimens, and, hopefully, in specimens of other geometries. The first test specimens of steel and aluminum are now in preparation and initial tests will begin in July.

 J_I -R CURVE KEY CURVE ANALYSIS

Researcher: Assistant Professor James A. Joyce

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

The objective of this project is to develop a method to obtain the J_I -R curve directly from a specimen load-displacement record. A methodology for this was proposed by P.C. Paris of Washington University in St. Louis, requiring a "key curve" evaluation from subsize specimens geometrically similar to the test pieces. The validity of this method has now been demonstrated for HY 130 steel and first results are to be published. Present work is now directed to a similar "key curve" evaluation for A533B reactor pressure vessel steel, which would allow re-analysis of irradiated specimen test results using data available through the Nuclear Regulatory Commission (Hanford Project, Richland, Washington).

STRESS ANALYSIS OF STERN DIVING PLANE

Researcher: Associate Professor William M. Lee

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

A stress analysis of the tapered fit between the stern-diving-plane stock and its hub (yoke) was undertaken. Torque transmitted through the fitted assembly was calculated by determining the interface pressures on

a series of cylindrical laminas. Based on the resultant interface pressures, the induced stresses in the hub were calculated considering the hub as a thick-walled cylinder. Stress values in the dimensions were determined. Based on the Von Mises criteria of failure, a resulting safety factor of 1.84 was found to exist for static load conditions. Because of the lack of definite information of hydrodynamic loads underway, no consideration was given for the torque and bending stresses. This analysis can also be extended to determine stresses in the hubs (yokes) of rudders and fair-water diving plane.

VIBRATIONAL RESPONSE OF PIPES EXCITED BY THE FLOW OF HIGH PRESSURE AIR AND HIGH PRESSURE WATER

Researcher: Professor J. Paul Uldrick

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

The objective of this research is to develop a design guide for predicting the structure-borne acceleration power spectral density on piping systems which convey either high-pressure air or high-pressure water.

A theoretical analysis has been developed employing modal analysis techniques for predicting the structure-borne acceleration power spectral density of pipes excited by either turbulent internal flow or by acoustic pressures. The theory relates the acceleration power spectra to the mechanical and geometrical properties of the pipe, the modal damping of the pipe/fluid system, the modal mass of the pipe/fluid, the excitation pressure spectra, the flow-rate through the pipe, and the joint acceptance between the excitation pressure field statistics and the mode shapes of the pipe.

Computer-aided analysis and graphics programs are being developed to predict the response of pipes conveying high-pressure air and to compare theoretical predictions to experimental measurements. A design guide is in preparation based upon these studies.

DYNAMIC J_{IC} FRACTURE TOUGHNESS MEASUREMENTS

Researchers: Assistant Professor James A. Joyce and Associate Professor Dennis F. Hasson

The objective of this work is to evaluate the elastic-plastic fracture toughness parameter J_{IC} from high rate tests. In elastic fracture mechanics, higher rates of testing produce dramatic reductions of crack resistance properties. It is not likely that this same effect will result in the elastic-plastic situation, since higher loading rates would be expected that will spread damage over a greater area and produce, in fact, a tougher material behavior.

Tests to date have been conducted on HY 130 steel at rates up to 125 in/min, which is 6 orders of magnitude faster than standard tests, without showing a marked change in the fracture toughness. These tests are to be continued with HY 80 steel, aluminum alloys, and titanium alloys. At a later date this work will be combined with the presently ongoing "Transition Temperature" study to determine the effects of rate on the ductile-to-brittle transition temperature in Navy steels.

 J_{IC} DEFINED TRANSITION TEMPERATURE EVALUATION IN NAVY STEELS AND TITANIUM

Researchers: Associate Professor Dennis F. Hasson and Assistant Professor James A. Joyce

The objective here was to obtain the elastic-plastic fracture toughness quantity, J_{IC} , for HY 130 steel tested statically at temperatures from -192°C to 150°C . In this range the fracture toughness varies dramatically showing a sudden drop below -100°C . A combination of J_{IC} , Charpy impact, and tensile mechanical data has been obtained over this temperature range. Scanning microscope fractography is now being completed. The results are generally as predicted, but nonetheless the demonstration that the J_{IC} fracture parameter can be evaluated over this wide range of properties is of immense value in applying J_{IC} as a fracture criterion in engineering structures.

PLANAR MECHANISM DESIGN WITH COMPUTER GRAPHICS

Researcher: Midshipman 1/C David S. Andrews

Adviser: Professor J. Alan Adams

Mechanisms make up the basic elements of the mechanical devices that surround us in our highly technical world. A mechanism is used to create a desired motion between a rigid body and some reference member. Thus the first step in designing any mechanical device is the kinematic design of the mechanisms which comprise it.

In general, there are three types of rigid bodies which are used separately or in combination to create the motion needed for plane mechanisms. These are the rotating guide, the two-link dyad, and the oscillating slider. It was the intent of this project to write computer programs in BASIC that solve the general case of each of these classes. The computer was used to show pictorial and graphical results of the problem solutions. The SGF data files stored from the pictorial output can be translated to the Tektronix 4051 tape-cartridge and used with the CADIG groups control program GENMILL to actually cut out the resulting mechanism.

Charles W. Radcliffe's and Chung-Ha Suh's book, Kinematics and Mechanisms Design, was the major source for this work. Their kinematic analysis of plane mechanisms using cartesian vector notation was chosen as the principal method to be used in computer programming.

The programming for the rotating guide and the two-link dyad and all supporting subprograms are now completed. The third case, the oscillating slider, has been left to be completed in another project in favor of modifying and experimenting with the results of the first two driver programs to create programs and output that will be usable by other students working with kinematics and mechanism design. The completed programs have also been designed in such a manner that future dynamic analysis programs can be readily adapted to calculate the forces and moments for the mechanisms as well as the kinematic motion.

HEAT LOSS AND HEAT GAIN LOAD CALCULATION COMPUTER PROJECT

Researcher: Midshipman 1/C C. J. Armitage

Adviser: Associate Professor Harry H. Keith

Air conditioning contractors need to calculate load requirements for the houses they work on, in order to estimate the cost and size of each unit and the operational costs to the general contractor. Many ways of making the load calculations have been developed by the major heat pump manufacturers and can be worked manually or by computer.

This project takes General Electric's approach and calculates, by use of the computer, the load requirements of a given house. Part One calculates, by room, the heat loss of the house. Part Two calculates, by room, the heat gain of the house. Finally, Part Three applies the losses and gains to various G.E. heat pump capacities and selects the best suited heat pump-air handler combination. The average annual costs of operation are also computed.

A COMPUTER GRAPHICS STUDY OF CYCLOIDAL MECHANISMS

Researcher: Midshipman 1/C Richard R. Bosco

Adviser: Professor J. Alan Adams

This project studies the various motions of cycloidal mechanisms. The cycloidal mechanism is basically a gear arrangement with the smaller gear being driven around the outside (epicyclic) or inside (hypocyclic) of the larger one. A pin attached to the smaller gear can be placed to describe various motions and, depending on the distance from the center of the gear, can be used for various purposes. This project studies this pin's role in a variety of uses: specifically, (1) when driving a slotted bar, (2) when driving a piston attachment, and (3) when driving a dwell-attachment. Using a Tektronix to display these mechanisms, and rotating them through their motions, the mechanisms were filmed in operation. Using equations of motion given by Tuttle's Mechanisms for Engineering Design, the graphs of the attachment's displacement, velocity, and acceleration can simultaneously be described.

Thus, the project investigated the various arrangements of cycloidal mechanisms, noted the effects of the hypocyclic versus epicyclic, and the pin placement on various attachments, and described these attachments' motions through films of the mechanisms in operation.

DESIGN GUIDE FOR FLOW NOISE IN PIPES

Researcher: Midshipman 1/C Henry F. Burns

Adviser: Professor J. Paul Uldrick

By employment of modal and spectrum analysis, it can be shown that the narrow-band vibrational response of pipes excited by turbulent flow noise depends upon the virtual mass of the fluid, the band average modal damping, the modal density, the pressure spectrum and the joint acceptance between the modes of the pipe and the statistics of the pressure field.

RESEARCH COURSE PROJECTS

MECHANICAL ENGINEERING DEPARTMENT

This project dealt with the development of computer programs to calculate the axial and joint acceptance functions for turbulence flow in straight pipe as a function of the pipe characteristics, and of the flow parameters. The graphic results allow the designer a simple method of calculating the joint acceptance of a given piping system.

COMPUTER SOFTWARE

Researcher: Midshipman 1/C James C. Davis

Adviser: Associate Professor Harry H. Keith

A computer program was developed for the PDP-1135 to provide graphic displays on a Tektronix 4051 terminal connected to a secondary output port.

In addition to standard X-Y plotting from a standard graphics file, sub-routines were developed for multi-variable graphic displays in real time while performing laboratory tests under computer control.

DIGITAL COMPUTER APPLICATIONS TO COMBUSTION ANALYSIS

Researcher: Midshipman 1/C Stephen C. Fessler

Adviser: Lieutenant Commander Leo J.M. Baird, USN

This project developed the use of the digital computer for various combustion analyses. The National Aeronautics and Space Administration thermochemistry programs in the Mechanical Engineering Department library were used to predict the chemical energy conversion characteristics for a variety of internal and external combustion process. Materials developed are for use in the course EM461, Combustion: Principles and Applications. This course includes laboratory work.

HYSTERESIS DAMPING OF COPPER IN TORSIONAL LOADING

Researcher: Midshipman 1/C James M. Fraser

Adviser: Professor Thomas W. Butler

Experimental determinations of small plastic strains in repeatedly-torqued copper tubes have been found. The object of the experimental work has been to determine the importance of hysteresis in the supposedly elastic portion of material response. The data is being fitted to the Kimball-Lovell quadratic damping law. Final experimental work and report are being completed.

INSTRUMENTED CHARPY IMPACT TESTING

Researcher: Midshipman 1/C F. Gierheiser

Adviser: Professor Thomas W. Butler

Results of normal Charpy impact tests give only a measure of the energy required to rupture a notched specimen. The present project was an attempt to obtain more information from this simple test with a modest increase in complexity. The striker of an impact tester was instrumented with resistance strain gages to allow a peak-stress in the striker to be determined. This peak-stress was to be correlated with the resistance of the Charpy specimen to deformation. Consequently, the peak-stress in the Charpy specimen, as well as the energy to rupture, was determined.

BOMB CALORIMETRY AND FUEL HEATING VALUES

Researcher: Midshipman 1/C Russ Keller

Adviser: Assistant Professor Eugene L. Keating

The development of bomb calorimeter facilities in Rickover Hall is currently in progress. Heating values for solid and liquid fuels can be experimentally obtained using this facility. The results of this investigation will allow properties of a variety of fuels such as coal, diesel fuel, charcoal, etc. to be compared to tabulated data. Materials developed are for use in the course EM461, Combustion: Principles and Applications. This course includes laboratory work.

A WIND TUNNEL STUDY OF THE AERODYNAMICS OF A TUNNEL-BOAT HULL IN GROUND EFFECT

Researchers: Midshipmen 1/C Robert A. Kloczek and Douglas E. Fremont

Adviser: Assistant Professor Thomas H. Reif

A recent study of the aerodynamics and hydrodynamics of a tunnel-boat hull showed that the aerodynamic drag forces are a significant percentage of the hydrodynamic drag forces, and that the residual drag was a small percentage of the total hydrodynamic drag. With these results in mind, it became apparent that the major performance improvements would come from aerodynamic changes as opposed to alterations in the wetted hull form.

Consequently, the objective of the present investigation was to obtain accurate measurements of the lift, drag, and pitching-moment so as to obtain a set of non-dimensional design curves for power and trim (angle of attack) requirements. These measurements were obtained both in and out of ground effect. The ground effect was found to increase the lift and drag, but decreased the lift-to-drag ratio.

DEVELOPMENT OF AN ELECTRONIC FUEL INJECTION SYSTEM FOR THE NAVAL ACADEMY
HEAT BALANCED ENGINE (NAHBE)

Researcher: Midshipman 1/C Brent B. Norman

Adviser: Lieutenant Commander Charles C. Failla, USNR

The NAHBE engine's unique requirements for a rich air-fuel mixture above the piston's cap and pure air below the cap suggests fuel injection as the ideal fuel-delivery system. The intent of this project was to design a fuel-injection system, having variable control over three inputs, (length of time of injector opening, volumetric flow rate, and dwell). Complete control over all three variables was obtained through the design of a sophisticated electronic system utilizing magnetic transducers, binary counters, potentiometers, and existing automotive injectors and fuel pump. The injector control system and associated hardware were integrated with an 8-horsepower Briggs and Stratton NAHBE engine, which was successfully test run.

A STEADY STATE FLOW STUDY OF A NEW PIVOTING DISC PROSTHETIC HEART VALVE

Researcher: Midshipmen 1/C Thomas Rychlik and Michael K. Welch

Adviser: Assistant Professor Thomas H. Reif

Laser-Doppler anemometer measurements of mean velocity and turbulence intensity are presented for the flow-field immediately downstream of a two-dimensional model of a pivoting disc prosthetic heart valve. Experiments were conducted for two different mounting eccentricities, $\epsilon = 0.14$ and $\epsilon = 0.17$, and for three different curvatures, $\phi = 0.000$, 0.057 , and 0.070 . The effect of valve closure was investigated for three different angles, $\alpha = 80^\circ$, 60° , and 45° . The Reynolds number, based on hydraulic diameter at the valve orifice, is kept constant at $Re = 7880$. Parametric studies indicate enhanced flow characteristics for the $\phi = 0.057$ geometry occluder. Similar studies of changes in eccentricity indicate that the smallest eccentricity which provides adequate opening characteristics should be used. Steady state flow measurements of pressure losses for the preferred curvature show substantial improvement over the standard Lillehei - Kaster prosthesis for the range of flow rates studied, $2500 < Re < 10^4$.

RESEARCH COURSE PROJECTS

MECHANICAL ENGINEERING DEPARTMENT

GASAHOL - FUELED WANKEL ENGINE PERFORMANCE

Researcher: Midshipman 1/C James Staudt

Advisers: Assistant Professor Eugene L. Keating and Lieutenant
Commander Charles C. Failla, USNR

This project experimentally studied the performance characteristics of a Wankel engine in Rickover Hall using both gasoline and alcohol fuels. The results of this investigation revealed the operating differences of a rotary engine using both conventional and alternate fuels. Materials developed are for use in the course EM461, Combustion: Principles and Applications. This course includes laboratory work.

INTERFACING A DIGITAL FREQUENCY ANALYZER TO A 4051 TEKTRONIX CALCULATOR

Researcher: Midshipman 1/C Doyle E. Thomas

Adviser: Professor J. Paul Uldrick

Several special-purpose programs exist for controlling a B&K type 2131 digital frequency analyzer with a 4051 Tektronix Desk-top Calculator. This project dealt with implementing and verifying the operation of these programs.

Additional general purpose programming routines have been prepared to transform the frequency analyzer/calculator system into a device that can be employed more efficiently in both a teaching mode and a measurement system.

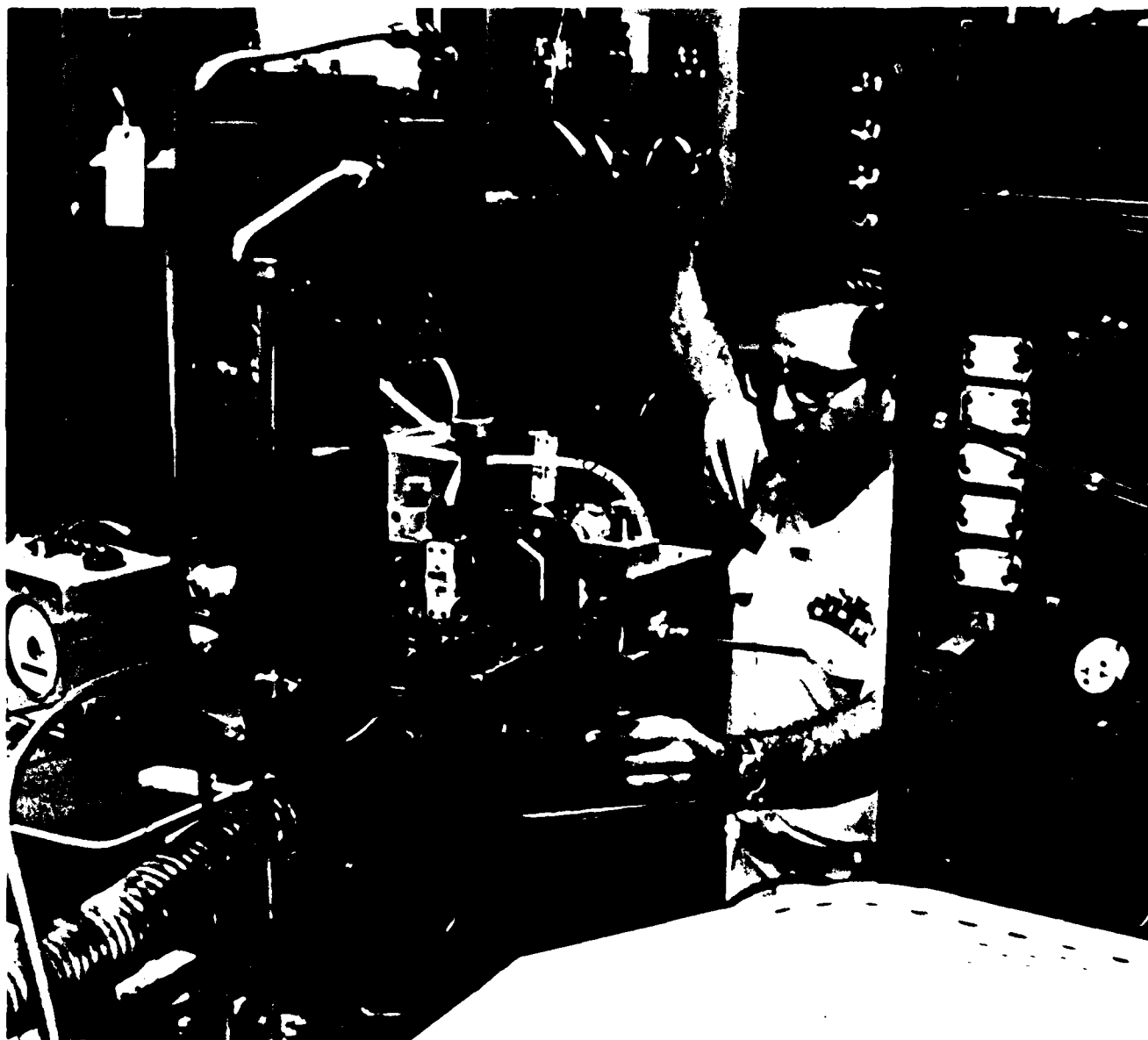
PERFORMANCE TESTS ON AN 8-HORSEPOWER BRIGGS AND STRATTON ENGINE USING CONVENTIONAL AND NAHBE CONFIGURATIONS

Researcher: Midshipman 1/C T. J. Wasylkiw

Adviser: Lieutenant Commander Charles C. Failla, USNR

The Naval Academy Heat Balanced Engine (NAHBE) is designed to increase the fuel efficiency and power output of the internal combustion engine while drastically reducing harmful exhaust emissions. This study was conducted to test the feasibility of converting a non-precision engine to the NAHBE configuration. A stock, 8-horsepower Briggs and Stratton tractor engine was equipped with a NAHBE Piston, a specially-machined piston rod, a modified bleed air carburetion system, and mounted on an electric dynamometer.

Readings of torque, fuel flow, air flow, exhaust gas temperature, internal pressure and exhaust by-products were obtained. Subsequent data was reduced via computer and plotted for analysis. Standard engine configuration curves were obtained first, followed by plots of the NAHBE modification. Initial results suggest that all three goals (higher power output, lower specific fuel consumption, and exhaust by-products that would meet emission control standards through the year 1985) were obtained.



GEREMIA, John O., Associate Professor, "Experimental Design to Evaluate Materials for the National Weather Service's Hydrogen Generators," National Weather Service Report, November 1978.

National Weather Service hydrogen generators operate under extreme temperature conditions. Materials for generator cells had to be selected and a test evaluation plan developed for selection of the best material from a group of possible materials. Tests are presently underway with two materials already meeting specifications.

GEREMIA, John O., Associate Professor, "'Screen Tests' For Product Design," Machine Design, 51 (26 April 1979), 176-180.

This paper describes how an experimental program can test a large number of independent variables with the objective of revealing the most important variables. Future experimental work then concentrates on a few critical variables.

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Fin-Cone Interference Flow Field," AIAA Paper No. 79-0200, 17th Aerospace Sciences Meeting, January 1979.

The general purpose of this investigation was to study the separated flow-field associated with a general fin-body or wing-body juncture. Specific objectives included: (a) determining the severity and extent of interference heating, (b) providing low visualization experiments to illustrate the flow structure, and (c) gathering a data base of heat-transfer and surface-pressure measurements to predict peak interference heating and peak pressure levels. A fin-cone configuration was tested at Mach 5. Heat transfer in the interference flow field was measured using the phase-change paint technique. Surface pressures were measured on the fin leading edge and on the cone ahead of the fin. These quantitative measurements were used in conjunction with both schlieren and oil-flow photographs in an effort to characterize the fin-cone interference field.

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Interference Heating Measurements Using Phase-Change Paints," AIAA Paper No. 79-1089, AIAA 14th Thermophysics Conference, June 1979.

In recent years the phase-change paint technique has evolved into an accepted diagnostic tool in high-speed wind-tunnel testing. The method is considered capable of providing reliable quantitative heat-transfer results for complex configurations with interference heating

patterns of unknown extent and location. This paper documents use of the method to study aerodynamic interference heating on fin-body configurations. Various aspects of the underlying theory and the experimental method are enumerated based both on experience and on information from other researchers. Analytic relationships are presented which indicate how uncertainties in the various input parameters affect the uncertainty in the heat-transfer coefficient. Advantages and disadvantages of the phase-change paint method are discussed.

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Seeding Effects in High Speed Flows," AIAA Paper No. 78-1143, AIAA 11th Fluid and Plasma Dynamics Conference, July 1978.

These experiments investigate the effects of seeding on the condensation of atmospheric moisture in a supersonic nozzle expansion. The experimental apparatus is an air-ejector-driven wind tunnel. Trimethylolethane (TME) seed is introduced into the ambient-air intake of the tunnel by heating pulverized TME in a closed oven and expanding the vapor through an orifice using nitrogen as a pressurizing gas. TME particles are collected about 5 cm downstream of the oven orifice on scanning-electron-microscope sample mounts for SEM verification of average particle size. Correlation of oven pressure and temperature with average TME particle size is of interest in order to know the nature of the heterogeneous seeding material. Continuous static pressure surveys are obtained using a motor-driven traversing stainless steel probe. Data are presented which show the effects of heterogeneous seed on the axial static pressure distribution in the nozzle expansion with respect to flattening and displacement of the condensation humps. Earlier work is cited, and the direction of the research is outlined.

HASSON, Dennis F., Associate Professor, co-editor, What Does the Charpy Test Really Tell Us?, Metals Park, Ohio: American Society for Metals, 1978.

This book consists of 13 papers presented at the 1978 annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers. Much attention is paid in this volume to the question of reconciling Charpy V-notch energy values with plane-strain fracture toughness. Many of the problems associated with Charpy tests are discussed and alternate tests are evaluated.

HASSON, Dennis F., Associate Professor, co-author, "Effect of Heat Input on Mechanical Properties of 4" Thick Ti 621/0.8 Mo GMAW-Spray Weld Metal," Report DTNSRDC/SME-78/99, April 1979.

Four-inch-thick Ti 621/0.8 alloy weldments were fabricated using the gas metal arc-welding spray technique in the flat position to determine the effect of different heat inputs (20,40 and 60 kilojoules/in) on certain weld-metal mechanical properties. No major differences in weld-metal chemistry, tensile properties, Charpy V-notch energy, dynamic-tear energy or mode of fracture that could be related to heat input were observed. A variation with respect to weld direction in the tensile yield and ultimate strengths was observed. Higher strengths were obtained in the longitudinal direction compared to the transverse direction; however, properties in both directions exceeded base metal requirements. Based on these results, choice of heat input can depend on deposition characteristics desired for weld pass location. This has been found to be an acceptable method for choosing parameters in multipass-welding of thick section alloy titanium by the gas metal arc-welding spray technique.

HASSON, Dennis F., Associate Professor, "Materials Analysis for Selection of Alloys for the NAHBE Pressure Exchange Cap," Engineering and Weapons Division Report EW-3-79, May 1979.

A materials selection analysis to determine suitable materials for the Naval Academy Heat Balanced Engine (NAHBE) pressure-exchange cap was performed. The analysis consisted of a metallographic and scanning-electron-microscope fractographic investigation of cast and extruded aluminum material caps from design testing programs on an air-cooled engine, and a materials selection study of several metallic alloys and a ceramic coating. Casting aluminum or non-heat treatable 5000-series aluminum and titanium alloys in the form of plate were proposed for the cap material. Studies of welding of the 5000-series aluminum and titanium materials to cast aluminum, and fuel/material compatibility with blended fuels were proposed.

JOYCE, James A., Assistant Professor, co-author, "Investigation of Specimen Geometry Modifications to Determine the Conservative J_I -R Curve Tearing Modulus Using the HY 130 Steel System," Fracture Mechanics, C. W. Smith, ed., 1979.

The objective of this work was to investigate the effects of face grooves and crack-length variations on J_{IC} and the tearing modulus of HY-130 steel. Compact specimen geometries (1TCT) with crack-length ratios of 0.55, 0.65, and 0.8, and face grooves of 12.5% and 25% total cross section reduction were tested using a computer interactive unloading compliance test technique. Results of these tests showed

that for this material, J_{IC} was independent of specimen geometry for the range of geometries evaluated. The tearing modulus, however, was higher in non-face grooved specimens, in which crack tunnelling occurred, and the tearing modulus was found to increase by a factor of two as crack length ratios increased from 0.55 to 0.8. In face-grooved specimens, the tearing modulus was found to be constant for the various crack-length ratios tested, at the lower bound of values developed with non-face grooved specimens.

JOYCE, James A., Assistant Professor, co-author, "J Integral Elastic-Plastic Fracture Mechanics Technology in the U.S. Navy," Proceedings of the Third International Conference on Mechanical Behavior of Materials, Cambridge, England: University of Cambridge, August 1979.

The United States Navy has historically been interested in the development of fracture-safe materials for ship construction, and in developing fracture-mechanics criteria for design considerations. Recently, a substantial research effort has been directed to the development of J-Integral technology. The purpose of this paper is to review recent Navy advances in this area. The main points included discussions of the applicability of the J-Integral to fracture in ductile materials, the development of test procedures for J_{IC} , recent results of the areas of J-controlled crack growth, dynamic J-Integral properties, and instability criteria based on the J_I versus crack growth resistance curve.

JOYCE, James A., Assistant Professor, co-author, "Computer Interactive J_{IC} Testing of Navy Alloys," Elastic Plastic Fracture, ASTM STP 688, 1979, pp. 451-468.

A computer interactive single specimen J_{IC} test procedure has been developed. This procedure utilizes an online mini-computer to analyze digitized load-displacement data during testing. Unique values of J_I and crack length are determined from compliance measurement on short unloadings along the load-displacement record. The test procedure is presented in detail, and analysis procedures are discussed.

Three tasks which demonstrate the validity and utility of the computer interactive test-method are discussed. Results for single specimen and multiple specimen tests are presented for HY 130, 10 Ni Steel, 17-4PH Steel, Ti-7Al-2Cb-1Ta, and Ti-6Al-4V which show close correspondence between the two methods. Tests on 17-4PH Steel compact tension specimens with various thicknesses and crack lengths are summarized and dimensional effects on J_{IC} and the J- Δa resistance curve slopes are discussed. Finally, tests on HY 130 specimens with various notch root radii demonstrate effects of notch acuity on J_{IC} .

JOYCE, James A., Assistant Professor, co-author, "Elastic-Plastic Fracture Toughness (J_{IC}) of High Strength Steels and Titanium Alloys," Report DTNSRDC 78/054, June 1978.

The elastic-plastic fracture toughness criterion J_{IC} has been determined for HY 80, HY 130, 10 Ni steel, 17-4PH steel, Ti-6AL-2Cb-1Ta-0.8 Mo, Ti-7AL-2Cb-1Ta and Ti-6AL-4V. Tests were carried out at room temperature using a multiple specimen test and method and a newly developed single-specimen computer interactive test procedure. J_I is shown to be an effective parameter in describing fracture toughness on the basis of both crack initiation and crack growth resistance. The computer interactive test procedure is shown to produce equivalent results when compared with the multiple-specimen method and possesses distinct advantages over that method.

KEATING, Eugene L., Assistant Professor, co-author, "Quasi-Equilibrium Air Standard Heat Balanced Cycle Analysis," Proceedings of the 13th Intersociety Energy Conversion Engineering Conference, Society of Automotive Engineers, August 1978, Volume III, pp. 2018-2026.

The Air Standard model of the cycle for the Naval Academy Heat Balanced Engine (NAHBE) has been investigated analytically. The "ideal" thermodynamic or heat-balanced cycle was studied parametrically to determine the influence of changes in geometry and heat input on predicted indicated engine performance. Values for the cycle-state points, as well as mean effective pressure and thermal efficiency, were obtained from the analysis as a function of variations in compression ratio and heat input. Comparisons are given with compatible Air Standard Otto and Diesel cycles. Results obtained for quasi-equilibrium indicate that, for equal compression ratios and total heat input, the heat-balanced cycle yields lower peak pressures than the Otto cycle and with optimum geometry yields higher thermal efficiency than the Otto cycle. Equilibrium reduces to the classic dual cycle.

KEATING, Eugene L., Assistant Professor, co-author, "Hydrogen Production from Nuclear Fission Products Waste Heat," Proceedings of the 2nd World Hydrogen Energy Conference, August 1978, Volume I, pp. 77-108.

An analysis has been made on the feasibility of producing hydrogen using fission product waste heat and its subsequent combustion in gas turbines. The work has been performed in three distinct phases.

In the first phase, a system using radioactive waste heat has been designed, one which produces saturated steam. This steam is sent through a turbogenerator to produce electricity. The electrical power output of this system has been calculated as a function of fission production decay time, solidified form of fission products, as well as numerous other parameters.

In the second phase, the electrical energy produced is used to electrolyze water, which in turn produces hydrogen. The amount of hydrogen produced (lb/hr) has been calculated for varying electrical inputs, electrolyzer efficiencies, and feedwater temperatures. This hydrogen is then assumed to be liquified and stored. Finally, the third phase considers the burning of this hydrogen in a standard marine gas turbine.

LEE, William M., Associate Professor, co-author, "Stress Analysis of the Stern Diving Yoke," Report DTNSRDC TM-2878-268, January 1979.

A stress analysis of the tapered fit between the stern diving plane stock and its hub (yoke) was undertaken. Torque transmitted through the fitted assembly was calculated by determining the interface pressures on a series of cylindrical laminas. Based on the resulting interface pressures the induced stresses in the hub were calculated considering the hub a thick-walled cylinder. Stress values in three dimensions were determined. Based on the Von Mises criteria of failure, a resulting safety factor of 1.84 was found to exist for static load conditions. Because of the lack of definite information of hydrodynamic loads underway, no consideration was given for the torque and bending stresses. This analysis can also be extended to determine stresses in the hubs (yokes) of rudders and fair water diving planes.

REIF, Thomas H., Assistant Professor, co-author, "A Laser-Doppler Anemometer Study of the Classical Hydraulic Jump," Symposium on Measurements in Polyphase Flows, ASME-WA-78, 1978, pp. 99-106.

A laser-doppler anemometer is used to investigate the mean velocity and turbulence characteristics of the hydraulic jump at the supercritical Froude number of 2.0. These results are compared to those obtained by previous investigators in an air model of the hydraulic jump. The mean velocity profile is shown to have a more pronounced curvature and the turbulence is found to be significantly higher in the actual hydraulic jump. The effects of the addition of the drag reducing agent, polyacrylamide, are also studied. Polymer addition has little effect on the mean velocity distribution in the roller of the jump, but increases the velocity downstream, particularly near the wall. The drag reducing agent

slightly increases the turbulence in the roller, but significantly decreases this quantity downstream.

REIF, Thomas H., Assistant Professor, co-author, "A Preliminary Flow Study of a Two-Dimensional Model of a Concave-Convex Pivoting Disc Prosthetic Heart Valve," Proceedings of the 7th Annual New England (Northeast) Bioengineering Conference, 1979, pp. 209-211.

De Waal has recently reported through cine angiographical techniques in dogs, that the opening characteristics of pivoting disc prosthetic heart valves can be significantly improved by using curved occluders. Further, Stein has shown, through comparative in-vitro studies of simulated aortic conditions, that the use of curved occluders can actually decrease the pressure drop or lost work due to friction.

In order to gain insight into the fluid-flow phenomena responsible for this enhanced performance, a two-dimensional model of a concave-convex pivoting disc prosthetic heart valve was constructed, and fluid dynamics studies were performed.

REIF, Thomas H., Assistant Professor, co-author, "A Comparative Study of the Aerodynamics and Hydrodynamics of a Tunnel Boat Hull," Journal of Hydronautics, 12 (October 1978), 166-168.

Over the past decade, the design and construction of the outboard raceboat hull has changed considerably. These changes have introduced higher speeds, smoother rides, and better handling to the sport. In an effort to gain insight into this enhanced performance, some preliminary fluid-flow experiments were performed on a scale model of a Molinari tunnel boat. The model used was a toy Molinari tunnel boat manufactured by K&B, a division of Aurora Products Corporation.

The preliminary fluid-flow measurements taken during the course of this study can be classified as follows:

- (1) A wind-tunnel study of the aerodynamic characteristics of the hull, and
- (2) A tow-tank study of the hydrodynamic characteristics of the hull.

Because of problems with scaling, the range of Reynolds numbers and Froude numbers encountered in this preliminary study are too low for direct design application. In fact, data are presently being collected on larger models in an effort to make the range of Reynolds and Froude numbers more realistic. However, when compared with similar data of

different boat designs on a relative basis, this information can be invaluable. In addition, the results of the flow visualization study suggest that the drag and stability of this particular hull-design can be improved significantly, e.g., eliminate the regions of separation by streamlining.

WU, Chih, Professor and Associate Professor Richard A. HIRSCH, "Computer-Aided Graph Paper Construction," Engineering Design Graphics Journal, 42 (Fall 1978), 38-41.

Curve fitting, regression analysis, and graphical estimation of population distribution parameters have great appeal in statistics, engineering science, economics and business, as well as in education. To fit a certain curve or distribution model, students in experimental courses are taught to plot and check their experimental points on a linearized graph paper. Basically, in order to use the curve-fitting or distribution-fitting procedure, a convenient transformation of the curve or the population cumulative distribution must be available that changes it into a linear form.

Unfortunately, many odd and seldom-used curve or distribution graphical sheets are not made commercially. It is the purpose of this paper to present a method to construct the needed graph sheet by the rapidly expanding technology of computer graphics. The method is explained by some examples.

WU, Chih, Professor, co-author, "Potential Naval Applications of Direct Energy Conversion Devices," The Naval Engineers Journal, 91 (February 1979), 87-96.

Direct energy conversion devices may be used as prime movers, refrigerating machines, etc. and are endowed with characteristics well-suited to diverse naval applications. Despite this, not much effort has been invested by the U.S. Navy in their development. There is a real and urgent need for substantial fundamental work to be initiated in this area. Developments of thermoelectric converters, thermionic generators, photovoltaic cells, MHD systems, and fuel cells are surveyed. A comparison between conventional energy conversion and direct energy conversion in size, weight, and efficiency is made. Potential utilization of these direct energy conversion devices to our Navy is studied.

WU, Chih, Professor and Associate Professor John O. GEREMIA, "Energy Awareness Demonstration Device," International Journal of Mechanical Engineering Education, (April 1979).

An energy-awareness demonstration-device is built to demonstrate how rapidly our energy reserve is depleted, how quickly and enormously our demand for energy grows, and how important energy conservation is to us.

WU, Chih, Professor, "Statistical Investigation of Shipboard Facilities Maintenance and Manpower Utilization," Proceedings of The Institute of Mathematical Statistics (IMS) Meeting #166, April 1979.

Facilities maintenance requires a considerable expenditure of man-hours and material resources. Because of a number of problems and practices, facilities maintenance is not always performed efficiently. New concepts for accomplishing better shipboard facilities maintenance have been developed which should improve performance, reduce man-hours and cost and improve skill and knowledge of facilities maintenance team personnel. The concepts involve an information management system, audio-visual training, and improvements in facilities maintenance equipment. The plan for applying different experimental conditions to experimental test ships to determine how such conditions may affect the criterions is presented in the paper. Execution of the experiment and statistical data analysis of the concepts will be performed following at-sea data collection.

WU, Chih, Professor, "Mechanical Modeling and Computer Simulation of the Depletion of Energy Reserve," Proceedings of Tenth Annual Pittsburgh Conference on Modeling and Simulation, April 1979.

A mechanical modeling device and a computer graphic simulation program of the depletion of energy reserve are made. In both cases, the total world energy reserve, the current energy usage annual growth rate, and the current energy consumption rate are given. One can view the energy shortage in terms of the rapidly falling levels in the simulated oil barrels.

PRESENTATIONS

MECHANICAL ENGINEERING DEPARTMENT

ADAMS, J. Alan, Professor, "Computer-Aided Design," SIGGRAF '78 Conference, Atlanta, Georgia, August 1978.

BUTLER, Thomas W., Professor, "Premature Failures of Aircraft Carrier Catapult 'Tension Bars' Caused by Ill-Conceived Redesign," 1978 Army Symposium on Solid Mechanics, Cape Cod, Massachusetts, October 1978.

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Seeding Effects in High Speed Flows," IAAA 11th Fluid and Plasma Dynamics Conference, Seattle, Washington, 10-12 July 1978.

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Vortex-Fin Interaction Flow Field Measurements," 4th U.S. - German Data Exchange Agreement Meeting on "Viscous and Interacting Flow Field Effects," Meersburg, Germany, 24-26 April 1979.

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Fin-Cone Interference Flow Field," 17th Aerospace Sciences Meeting, New Orleans, Louisiana, 15-17 January 1979.

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Interference Heating Measurements Using Phase-Change Paints," AIAA 14th Thermophysics Conference, Orlando, Florida, 4-6 June 1979.

JOYCE, James A., Assistant Professor, "Application of Elastic-Plastic Fracture Mechanics in the U.S. Navy," Naval Research Reserve Unit VTU 0601, U.S. Naval Academy, 18 July 1978.

JOYCE, James A., Assistant Professor, "Elastic-Plastic Fracture of Navy Materials," U.S. Naval Academy Sigma Xi Chapter, 20 September 1978.

JOYCE, James A., Assistant Professor, "Experimental Calibration Function Determination and Application to the Evaluation of J-Resistance Curves Directly from Load Displacement Records," 12th National Conference on Fracture Mechanics, ASTM, Washington University, St. Louis, Missouri, 21-23 May 1979.

PRESENTATIONS

MECHANICAL ENGINEERING DEPARTMENT

JOYCE, James A., Assistant Professor, "Investigation of Specimen Geometry Modifications to Determine the Conservative J_I -R Curve Tearing Modulus Using the HY 130 Steel System," 10th National Symposium on Fracture, Virginia Polytechnic Institute, Blacksburg, Virginia, 12-15 June 1978.

JOYCE, James A., Assistant Professor, "J Integral Elastic-Plastic Fracture Mechanics Technology in the U.S. Navy," Third International Conference on Mechanical Behavior of Materials, University of Cambridge, Cambridge, England, 21-24 August 1979.

JOYCE, James A., Assistant Professor, "Specimen Geometry Effects on the J_I -R Curve for A533B Reactor Pressure Vessel Steel," 12th National Conference on Fracture Mechanics, ASTM, Washington University, St. Louis, Missouri, 21-23 May 1979.

JOYCE, James A., Assistant Professor, "Materials Data Acquisition Applications in the Materials Science Laboratory," Annual Conference of the American Society for Engineering Education, Louisiana State University, Baton Rouge, Louisiana, 25-28 June 1979.

JOYCE, James A., Assistant Professor, "Use of the 'Key Curve' Analysis Method to Evaluate J_I -R Curves Directly from Specimen Load Displacement Records," Nuclear Regulatory Commission Research Review, Silver Spring, Maryland, 5 February 1979.

JOYCE, James A., Assistant Professor, "Computer Interactive J_{Ic} Fracture Toughness Testing," Materials Division, National Bureau of Standards, Gaithersburg, Maryland, January 1979.

REIF, Thomas H., Assistant Professor, "A Laser-Doppler Anemometer Study of the Classical Hydraulic Jump," Winter Annual Meeting of the ASME, San Francisco, California, 10-15 December 1978.

PRESENTATIONS

MECHANICAL ENGINEERING DEPARTMENT

REIF, Thomas H., Assistant Professor, "A Preliminary Flow Study of a Two-Dimensional Model of a Concave-Convex Pivoting Disc Prosthetic Heart Valve," 7th Annual New England (Northeast) Bioengineering Conference, Rensselaer Polytechnic Institute, Troy, New York, 22-23 March 1979.

WU, Chih, Professor, "Computer-Aided Graph Paper Construction," 1979 ASEE Annual Conference, Louisiana State University, Baton Rouge, Louisiana, 25-28 June 1979.

WU, Chih, Professor, "Mechanical Modeling and Computer Simulation of the Depletion of Energy Reserve," Tenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 25-27 April 1979.





NAVAL SYSTEMS ENGINEERING DEPARTMENT

Professor Peter F. Wiggins, Chairman



Research in the Naval Systems Engineering Department plays a vital role in the professional enrichment of both midshipmen and faculty. During Academic Year 1978-1979, faculty members and midshipmen participated in numerous and varied projects in the fields of marine engineering, ocean engineering, and naval architecture.

A number of varied projects were undertaken, both funded and unfunded. These include faculty research in the areas of ocean wave studies, composition ship hull-form studies, sediment shear-strength, wave-energy studies, hydromechanics laboratory development, energy conservation, ocean-energy resources, neutron-activation studies, condenser studies, power-plant-reliability studies, boundary-layer studies, ocean thermal-energy conversion, ship-vibration studies, dynamics of marine vehicles, fission-fragment-decay heat studies, environmental protection programs, and faculty-sponsored midshipman projects in the areas of hydrofoil small waterplane area single-hull performance studies, ocean current power-plant design, ship rudder studies, seakeeping studies, marine power-plant studies, ocean-wave analysis and wave-energy conversion buoy-studies.

Support for research is found in many sources, from departmental operating funds to contracts and grants from such diverse organizations as the Naval Academy Research Council, the Naval Sea Systems Command, the U.S. Coast Guard, and the David W. Taylor Naval Ship Research and Development Center.

Research and design projects, as in the past, have continued to display the originality and variety typical of the Naval Systems Engineering Department faculty and undergraduate majors. The Department will continue to pursue an aggressive commitment for research for the midshipmen and faculty that provides the needed scholarly activity to maintain an outstanding undergraduate program. Many of the faculty members of the Department are internationally known for their contributions in their respective fields.

AN ATTEMPT TO DETECT THE IMPORTANCE OF TURBULENT BOUNDARY LAYER IN SHIP-WAVE RESISTANCE FORMULATION

Researcher: Assistant Professor Sander M. Calisal

Sponsor: Naval Academy Research Council

The Reynolds number of a ship model is increased artificially by using a flat plate leading the model. The turbulence level of the flat plate boundary layer is also altered. A decrease in the calculated wave resistance and measured residual resistance is observed within the Froude number range $L < Fr < 4$. The results indicate a viscous - wave resistance interaction which can be formulated in terms of the visco-elastic properties of a turbulent flow. A possible formulation using this procedure is also indicated.

DYNAMIC RESPONSE OF OCEAN STRUCTURES

Researcher: Associate Professor Thomas H. Dawson

Sponsor: Naval Academy Research Council

This work is concerned with the analysis of the response of elastic systems to ocean waves and with the description of the forces exerted on ocean structures and their components by the ocean waves.

Recent progress has included the successful analysis of the effect of an elastic sea-floor on the overhead water-waves. Classical theory assumes a rigid sea-floor which is unrealistic for shallow water-waves propagating over a soft bottom. Work by Mallard and Dalrymple (1977) at the University of Delaware extended this treatment to allow for a deformable elastic sea-floor but failed to include the inertia of the sea-floor. The present work included both elasticity and inertia and revealed two distinct waves in the water-soil system.

Recent work has also included the study of wave-forces on cylinders inclined to the vertical. This topic is of interest in calculating the forces on inclined (bracing) members of ocean structures. Experiments using the Naval Academy Towing Tank have been carried out for both vertical and inclined cylinders and the wave-forces measured for various wave-periods. These experiments resulted from collaboration with Assistant Professor Joseph D. Gillerlain, Jr. of the Mechanical Engineering Department and should shed new light on the proper application of wave-force formulas to inclined members. The analysis of the data and a paper describing the results is forthcoming.

Continuation of the research is expected under an ONR research grant.

INVESTIGATION OF THE USE OF MONOFILAMENT SPIRALS FOR REDUCTION OF MARINE-FOULING IN HEAT-EXCHANGER TUBES

Researcher: Assistant Professor William B. Huckenpoehler

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

This was an investigation of a method of cleaning marine-fouling from the oceanside (interior) of heat-exchanger tubes through the use of spirally-formed coils of plastic monofilament rotating on a swivel inside the tube to determine whether the method would be feasible for use in connection with Ocean Energy Thermal Energy Conversion Plants. In particular the investigation was concerned with: (1) methods for fabrication of test coils; (2) methods of attachment and ability of coils to turn at representative water-flow rates; (3) diameters and pitches of coils best suited for the purpose; (4) actual ability of spirals to prevent growth of marine-fouling on interior tube-surfaces; and (5) effects of spiral use on heat-transfer properties of the tubes.

Methods of manufacturing test-coils and swivel-attachments were investigated and a series of coils of various weights of nylon monofilaments were produced. A test set-up was designed and built at DTNSRDC, and several of the coils were installed for long-term tests. Results seemed to show some promise but before heat-transfer could be made the project funds from the Department of Energy were withdrawn and the project was cancelled.

SEAKEEPING OF NAVAL SHIPS

Researcher: Professor Edward V. Lewis

Sponsor: Naval Sea Systems Command

An important "Workshop" was held at the Naval Academy in 1975. Discussions at that time led to some definite recommendations regarding needed research directed toward incorporating seakeeping theory and knowledge into the design process for naval ships. An assessment of progress in this direction would appear to be timely and useful. It would involve interviewing individuals and groups in the Navy engaged in seakeeping research and application to design, to ascertain progress that has been made and research projects now in progress or planned. It would lead to conclusions and recommendations regarding future research priorities.

The object of this study is to survey recent progress in seakeeping research, including current projects underway, and make recommendations regarding new projects needed, with their priorities.

The first phase, consisted of library research, interviews with personnel of DTNSRDC, NAVSEC, Coast Guard, MARAD, research laboratories etc., attendance at meetings and conferences, and preparation of notes on the above.

The second phase, will cover the preparation of a survey report, with research recommendations.

In the course of surveying current seakeeping research and drafting a plan for future work, it is anticipated that one or two specific topics will be identified in which the investigator can make some contribution in the form of a short study, with results presented in an article or paper.

Good progress has been made on the first phase of the project.

EARLY STAGE DESIGN PREDICTIONS ON THE INTACT TRANSVERSE STABILITY OF A SHIP

Researcher: Assistant Professor Bruce C. Nehrling

Sponsor: Naval Academy Research Council

The objective of this continuing research project is the derivation of a set of analytic expressions which will enable naval architects to predict the intact transverse-stability-indices of a monohull displacement ship during preliminary design.

Hull-form data for a sample population has been collected and the intact stability characteristics of these ships computed. A statistical analysis and step-wise regression is being performed on the accumulated data. To date, initial sets of analytic expressions have been developed which appear to adequately predict the influence of hull-form parameters on a ship's intact transverse-stability.

It is anticipated that this information will improve the procedure for defining the ship's initial lines as well as minimizing the possibility of not satisfying a given set of stability criteria.

FLOW PATTERNS AND VELOCITY MEASUREMENTS IN A POWER PLANT CONDENSER WATERBOX

Researcher: Assistant Professor Clyde C. Richard

Sponsor: Naval Academy Research Council

Condenser-tube inlet-end erosion continues to plague the power industry. Not only are plants derated and outages for plugging leaking condenser tubes bothersome, they are costly. One of the mechanisms that results in tube-erosion is poor hydraulics, caused from inadequate inlet piping and condenser-waterbox design. This paper discusses testing done on a scale model of a nuclear power plant condenser-waterbox. Flow observations using air bubbles and dyes were made to locate areas of flow separation and recirculation. Velocity measurements were made in regions of interest. To quantify the condition of the flow, a velocity shift parameter was developed. After studying the hydraulics of the actual system, turning vanes were added in the waterbox to improve the flow. A comparison of the hydraulics with and without the turning vanes is made.



BUILDING HEAT LOAD CALCULATIONS

Researcher: Lieutenant Kristin L. Allen, USN

This research is principally concerned with reducing an already existent, complex, commercially-available heating and cooling load-computer program into a series of simplified procedures which can be readily coded for use on a programmable (SR58/59) calculator. These procedures and associated monographs, would allow comparatively inexpensive analysis of transient heat-load calculations of residential and small commercial buildings. Such analyses are fundamental in quantifying costs associated with various alternative solar building designs.

A COMPARATIVE STUDY OF NAVAL ESCORT HULL FORMS

Researcher: Associate Professor Roger H. Compton

Comparative effective horsepower in still water and vertical plane motions in regular, long-crested head-seas are determined for 425' destroyers from the testing of two 5' models in the USNA 120' Towing Tank. The experimental results are compared with analytical predictions and large model results.

Data were acquired and analyzed both manually and using the laboratory's extensive computer system, and results were compared.

An attempt to relate performance differences to hull shape differences is made and described.

This is ongoing work which has involved two earlier midshipman projects.

MEASUREMENT OF LOW FREQUENCY SOUND IN THE OCEAN

Researcher: Associate Professor Richard S. Rothblum

This is a continuing program to extend the capability of acquiring acoustic data in the oceans to a lower frequency range than is now possible using surface-suspended systems. The effort this year has been concentrated on analyzing data acquired during the summer of 1978 and preparing it for publication. Preliminary results indicate that a significant advance has been made and that the remaining difficulties will be in developing a system more convenient for shipboard use or remote deployment.



DYNAMIC BEHAVIOR OF A REACTOR DURING REACTIVITY INDUCED TRANSIENTS

Researcher: Midshipman 1/C Edward Berko

Adviser: Associate Professor Martin Nelson

A simple-lumped-parameter thermal reactor model has been designed to demonstrate the dynamic behavior of power reactors during reactivity-induced transients. Four linear differential equations are used to describe the transient behavior of the power, temperature, and precursor concentration in the reactor core. One-group-point kinetics equations are used to describe the time-dependent core-power while reactivity is assumed to be a function of reactor temperature. Also, an energy balance is used to analyze the heat stored in the coolant within the core volume. These four-coupled differential equations are solved on an analog computer. The results provide a description of the interaction of the various phenomena in a reactor transient.

SURFACE WAVE CREATION BY AN OCEAN CURRENT CONVERTER

Researcher: Midshipman 1/C William H. Borger

Adviser: Professor Michael E. McCormick

A 1/170 scale geosim of a ducted ocean-current energy-conversion propeller was designed, constructed, and tested in the towing tank to determine the size of the surface-wave created by the turbine in a scale 6-knot current. The model included the shroud only. The prototype of this model is the Coriolis I of the Aerovironment Company, which is designed to convert 75 MW of the Florida Current. The tests showed no significant wave-generation and, thus, no environmental problem of this type.

FULL SCALE SAILING YACHT TESTS

Researchers: Midshipmen 1/C Nevin P. Carr and David D.N. Vann

Adviser: Lieutenant Commander Edmund C. Munger, USN

The purpose of this project was to instrument a sailing yacht to measure the relative-wind angle, relative-wind speed, and four yacht-performance variables. The four performance variables measured were boat speed, heel angle, leeway angle, and rudder angle. A number of parametric computer models have recently been developed which predict, for a given yacht, geometry and wind condition, one or more of these measured variables. Measurements taken during this project will provide a body of data with which parametric algorithms may be evaluated and validated. The measurements also provide the first near real-time measurements of the performance variables for dynamic analysis of the yacht system. The project included the design and fabrication of a measurement and recording system for installation on board a 37-foot sailing yacht. On board and developed sensors were calibrated in the laboratory utilizing the wind tunnel and the 120-foot towing tank. Initial afloat tests were conducted in nine relative-wind conditions. These data are presently being examined to evaluate the effectiveness of the measurement package. Depending upon this evaluation, the measurement package will be modified if necessary, and a future project may be conducted to provide an increased data base for further system analysis.

AN EXPERIMENTAL INVESTIGATION OF A SURFACE PIERCING RUDDER

Researchers: Midshipmen 1/C Peter L. Carrier and R. D. Fitzpatrick

Adviser: Associate Professor Roger H. Compton

A side force-drag dynamometer for use in the USNA circulating water channel (or either towing tank with minor modification) was conceived, fabricated (using modular force gages already on-board in the laboratory), calibrated, and operated by the midshipmen. A surface-piercing rudder shape was tested using the dynamometer, and the results obtained were compared with analytical results from the open hydrofoil literature. Agreement was excellent, and both normal and ventilated conditions were investigated. The dynamometer appears well-suited to subsequent midshipmen rudder testing in courses like EN-459.

SOVIET NUCLEAR POWER REACTOR SAFETY

Researcher: Midshipman 1/C Kevin Delancy

Adviser: Associate Professor Martin Nelson

Soviet nuclear-power reactors are designed much in line with Western safety philosophy. In both cases, we see an awareness of safety which goes beyond normal power industry standards, exemplified by the use of redundant systems, components of extra quality, and in the use of statistical fault-analysis. However, the Soviets ignore the possibility of the accidents which set the safety standards for U. S. reactors, such as the loss of coolant accident, core meltdown, and rod rejection.

SAFETY PROBLEMS OF A LIQUID METAL FAST-BREEDER REACTOR

Researcher: Midshipman 1/C Charles Doty

Adviser: Associate Professor Martin Nelson

The need for breeding reactors is evident today, as the reserves of U-235 are depleted. Most research, both in the United States and abroad, is in the liquid metal fast-breeder reactor area. Safety is, of course, of prime concern in such a system.

Sodium acts as the coolant and heat-transfer medium in most LMFBR's. Certain characteristics of sodium make it the best material available for such purposes. These include both its nuclear and heat-transfer properties.

Other sodium characteristics make safety in the LMFBR a problem, more so than in a PWR. Very large control-rods, and the lack of a moderator can hamper efforts to control excess reactivity. Leaking liquid sodium is a highly reactive, dangerous substance, and can precipitate large releases of radioactivity into the atmosphere. Control of radiation under normal operating conditions alone requires more extensive protective measures than a PWR.

PROBLEMS ENCOUNTERED IN USING NA-I ACTIVATION ANALYSIS TO DETERMINE
CONCENTRATIONS OF HEAVY METALS IN CHESAPEAKE BAY SOFT SHELL CLAMS

Researcher: Midshipman 1/C Robert J. Engel

Adviser: Assistant Professor Clyde C. Richard

One of the most significant factors in man's ever-changing environment is industrial wastes which are dumped into rivers and oceans. In an effort to chart concentration levels of heavy metal-waste in the Chesapeake Bay, a project was undertaken to use neutron activation analysis to quantify the heavy-metal content of soft shell clams selected from various regions of the Bay.

The basic theory, apparatus, procedure, and results are discussed. The results of this project were unsatisfactory. Several of the problems that made analysis of the data impossible are described including a problem with a large and changing background reading.

The conclusion is drawn that the particular Na-I activation-analysis system used in this experiment does not work well when the sample mass and the concentration levels are small.

FRESNEL WATER WAVE FOCUSING

Researcher: Midshipman 1/C Lanny B. Glover

Adviser: Professor Michael E. McCormick

The U. S. wave-energy-conversion program has been directed toward the focusing of wave energy so that relatively small devices could convert large amounts of wave energy. Tests of one of these focusing techniques, Fresnel focusing, were conducted in the coastal engineering tank. Fresnel "lens"-type wave diffractors made of surface-piercing piles and also, of lens-shaped submerged platforms were used. The platforms were found to be most effective in focusing wave energy since the "lens" was somewhat independent of direction. The pile system was both frequency-and directional-dependent and, thus, found to be unsatisfactory.

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THE DESIGN AND ANALYSIS OF A VERTICAL AXIS OCEAN CURRENT POWER PLANT

Researchers: Midshipmen 1/C John R. Hartzog, Robert V. Sorge,
John V. Quigley, and George R. Adams

Adviser: Assistant Professor Clyde C. Richard

Although ocean currents have a low overall energy density and limitations exist on the total extractable amount of energy without seriously affecting the environment, the energy potential of ocean currents is enormous. It is presently estimated that the total energy in the world's ocean currents exceeds 5×10^{12} watts. This is more than the total energy in the flow of all the fresh water rivers in the world.

This paper discusses a detailed calculation of the power generated by a vertical axis ocean current power plant. An analytical model is presented and a computer solution described. Results of the calculation consist of plots of the optimum angles of the blades about the vertical axis to maximize power output, the instantaneous power for various blade positions, and the total power of the plant for various design parameters, i. e. , blade lengths and widths. Tow tank tests are described for a 1 to 70 scale model of the proposed plant. Test results are shown and compared to the analytical predictions of the computer model.

AN EXPERIMENTAL INVESTIGATION OF THE HYBRID SHIP CONCEPT: HYSWAS

Researchers: Midshipmen 1/C Douglas Houseman and Larry D. Linn

Adviser: Associate Professor Roger H. Compton

A pioneering effort in experimentally evaluating the hydrodynamic performance of HYSWAS (Hydrofoil Small Waterplane Area Single Hull)-- a hybrid ship which derives its sustentation from a 70% buoyant force, 30% dynamic lift combination--was performed in the 380' towing tank. The model was borrowed from DTNSRDC, Carderock, and was tested without foils fitted to check and extend a series of tests conducted at DTNSRDC's Langley Field towing tank. On the basis of these tests (both free and restrained in calm water), a set of symmetric hydrofoils were installed on the model and the test matrix was rerun. It appears that the HYSWAS concept is feasible from a hydrodynamic standpoint and may have the advantages of a humpless speed-power relationship and the ability to maintain high speed in waves claimed by its proponents. Further work in waves is planned.

FUSION: THE PROBLEMS IT POSES TO MODERN TECHNOLOGY

Researcher: Midshipman 1/C Robert Huddleston

Adviser: Associate Professor Martin Nelson

Fusion has been hailed as the one source of power that could save our world from energy exhaustion. As we foresee severe shortages of fossil fuels and greater demands for them in the not too distant future, it is not too surprising that more and more research is being done on solving the fusion problem. But what is the problem right now? What prevents our modern technology from harnessing the seemingly endless supply of power from nuclear fusion reactors? When can we expect fusion to become a reality? This paper deals with these questions by discussing the more promising approaches for fusion confinement, and researching some of the latest estimates of its becoming a reality.

THE INERTIAL CONFINEMENT FUSION REACTOR: SOME COMPONENT DESIGN CONSIDERATIONS

Researcher: Midshipman 1/C Ivars Ikstroms

Adviser: Associate Professor Martin Nelson

This project was concerned with an overview of some physical limitations in constructing an inertial confinement fusion reactor and the present solutions to some of those problems.

Three main areas were considered:

1. Fuel manufacture. Flawless microballoons, which are to contain the deuterium-tritium fuel mixture, must be selected, filled with the fuel, and coated with a high Z-number material, as well as a plastic, in very large quantities in order to sustain commercial reactor operation.

2. Reaction initiating energy source. A high energy source capable of short pulses, but fast pulse-repetition rates is essential. Furthermore, the ability to cool the source, high efficiency, and a prolonged period are desirable. So far, the CO₂ gas laser has proved to be the best energy source.

3. The reactor cavity. The microexplosions caused by fusion create small high-energy particles and x-rays. These can damage the reaction chamber unless special materials are employed to absorb the particles, or other means are used to attenuate the particles before they strike the reactor vessel.

COUNTER-ROTATING WAVE ENERGY CONVERSION TURBINE

Researchers: Midshipmen 1/C Philip C. Jolly and J. T. Newmaster

Adviser: Professor Michael E. McCormick

A quarter-scale wooden model of the McCormick counter-rotating wave-energy-conversion turbine was designed, constructed, and tested. This design requires no flaps or gates to direct the wave-induced air motion. The design will be used as the U. S. Turbine in the cooperative wave-energy-conversion project to be conducted in the Sea of Japan, under the auspices of the International Energy Agency.

THE EFFECT OF SURFACE WAVES IN A SUBMARINE OPERATING NEAR THE SURFACE

Researcher: Midshipman 1/C Richard D. Lanning

Adviser: Associate Professor Roger H. Compton

An experimental study of the suction forces and pitch moments on a submerged body of revolution at zero and selected forward speeds in long-crested regular head-seas was performed in the 120' tank. Model speed and submergence were varied, as was wave frequency. The results are analyzed and compared to analytical prediction.

EXPERIMENTAL ANALYSIS OF THE SUCTION FORCE ACTING ON A SUBMERGED BODY OF REVOLUTION

Researcher: Midshipman 1/C Richard D. Lanning, Jr.

Advisers: Associate Professors Roger H. Compton and Maido Saarlax

An experimental program was designed and executed in the 120' towing tank to measure the vertical forces on a near-surface-submerged Series 58 body of revolution. The effects of model forward-speed, submergence, and

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wave length (maintaining constant wave slope) were investigated. Both regular and irregular long-crested head-sea conditions were investigated. The experimental results were compared to analytical predictions performed previously at DTNSRDC. An analog computer simulation of the vertical motion of the body of revolution was attempted.

A SURVEY OF RESEARCH EFFECTS OF LOW-LEVEL RADIATION

Researcher: Midshipman I/C Ricardo P. Lillo

Adviser: Associate Professor Martin Nelson

Low-level radiation is a controversial issue and concerns every person who works at a nuclear power plant. In this paper the effects of Low-level radiation on human life are examined.

This paper examines the study of Dr. Thomas Mancuso at the Hanford plutonium factory in Washington State, and the study of Dr. Irwin Bross concerning x-rays analysis.

Also in review is an article written by Dr. Baskev Sanders titled "Low-Level Radiation and Cancer Deaths".

SEAKEEPING CHARACTERISTICS OF THE CANADIAN HULL SERIES FOR HIGH SPEED SHIPS

Researchers: Midshipmen I/C Todd P. Mairs and Jose Gonzales

Adviser: Professor Bruce Johnson

The purpose of this project is to make seakeeping tests in irregular waves on the first of a Canadian Hull Form Series for high speed displacement ships. This is a cooperative project with the National Research Council of Canada. NRC has performed the regular wave tests on these models, which are the most complete series variation in hull form parameters for destroyer-type ships. Regular and irregular wave tests were performed.

RESEARCH COURSE PROJECTS

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A NAVAL ARCHITECTURE DESIGN INFORMATION SYSTEM

Researcher: Midshipman 1/C Bruce Martin

Adviser: Associate Professor Roger H. Compton

A study of available technical-information systems augmented by a systematization of the design resources available at USNA was undertaken. The direct result of the study, a multipage brochure "A Guide to Naval Architecture Design Information at the U. S. Naval Academy" was produced for distribution to the faculty and to midshipmen involved in ship design at USNA.

PARAMETRIC OPTIMIZATION FOR MORC (4Q) RULE

Researcher: Midshipman 1/C Kevin B. Mathison

Adviser: Lieutenant Commander Edmund C. Munger, USN

The purpose of this project was to develop a computer program which calculates, for a specific race course in given wind conditions, the optimum geometric parameters for a sailing yacht competing under the Midget Ocean Racing Club's 4Q measurement and handicapping system. The optimization program utilizes a modified version of a computerized parametric model which predicts a sailing yacht's speed when the wind conditions and the boat's geometry are specified. An algorithm which calculates the yacht's rating in terms of five important geometric parameters was developed. These parameters were waterline length, displacement-to-length ratio, length-to-beam ratio, length-to-draft ratio and sail area. These parameters were varied in a stepped-exponentially-weighted random search that gives the values of the parameters which will provide the minimum corrected time in completing a specified race course. If afloat tests that are being conducted in parallel with this project validate the parametric model, the optimization program will provide a set of parameters upon which preliminary design of yachts rated under the MORC rule may be based.

WASTE MANAGEMENT ALTERNATIVES

Researcher: Midshipman 1/C Roger G. Mau

Adviser: Associate Professor Martin Nelson

As the use of nuclear power becomes more widespread, the problem of final disposition of waste material requires immediate solutions. Many methods of handling have been studied, including recycling, geologic storage, transmutation, ejection from earth, and seabed disposal.

Currently, the most favored methods are recycling and geologic storage. Industry favors recycling to recover fissionable material and valuable radioisotopes. This method reduces the amount of waste to be disposed of. Environmentalists favor geologic disposal for security and exposure reasons.

This paper presents an overview of these methods and their economic and technological aspects.

BREEDER REACTORS: CAN WE DO WITHOUT THEM?

Researcher: Midshipman 1/C William H. Meader

Adviser: Associate Professor Martin Nelson

With the growing energy crisis, alternate sources of power must start to be utilized or nations could be in trouble. Nuclear fusion is a possible long term answer, but it cannot be harnessed for at least another 30 years. Nuclear fission is helping, but the United States is running out of fissionable uranium. Breeder reactors appear to be one of the answers that can help out today. This paper examines the assets and liabilities of breeder reactor technology.

SEDIMENT MOTION NEAR HILTON HEAD

Researcher: Midshipman I/C Peter F. Reeves

Adviser: Professor Michael E. McCormick

A scale model of a harbor near Hilton Head was designed, constructed and tested in the coastal engineering tank. The purpose of the test was to determine the cause of the high sediment-transport within the harbor. Waves of various heights and periods were studied and the direction of the littoral transport determined. A model of a breakwater was then placed at various offshore positions to determine the optimum in reducing the sediment motion.

"SEABROOK VS THE CLAMS"; THE FIGHT GOES ON

Researcher: Midshipman I/C Dana Swenson

Adviser: Associate Professor Martin Nelson

A major battle that could affect the energy policy of the United States has been swirling around the seacoast community of Seabrook, New Hampshire. On one side is the Public Service Company of New Hampshire (PSNH) and opposing them is a group by the name of the Clamshell Alliance.

PSNH was made an exception to the Environmental Protection Agency's requirement that all new nuclear plants use cooling towers to dissipate heat through evaporation. Instead, Seabrook will draw seawater from three miles offshore through a 19 ft. diameter tunnel and then return the water 39°F warmer to the ocean.

The Clamshell Alliance claims that the seawater used to cool the reactors would be heated enough to endanger marine life. Regional EPA officials agreed that the cooling tunnels would be taking in and discharging much too close to clam spawning grounds.

Protestors are staging mass demonstrations at the plant site. Hearings are being held by the Nuclear Regulatory Commission and the EPA. The stopping of work will leave over 2000 laborers without jobs. Now the PSNH is having problems in that its investment in Seabrook may be too big. The battle still goes on without a winner in sight.

RESEARCH COURSE PROJECTS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

WAVE-MAKING RESISTANCE REDUCTION THROUGH PRESSURE EQUALIZATION

Researcher: Midshipman 1/C Frank G. Scholley

Adviser: Assistant Professor Bruce Nehrling

The purpose of this project was to propose and analyze methods for equalizing the pressure distribution around a moving ship in order to reduce the hull's wave-making resistance. If this type of resistance can be reduced without a corresponding increase in another type of resistance, then the power required to propel the ship at a given speed can also be reduced. Various methods were investigated. The most promising method, a horizontal Y-tube at the ship's bow, was tested on a cargo-ship model in the Naval Academy's Hydrodynamics Laboratory. This Y-tube permitted the high pressure bow-wave to be suctioned off at low pressure points along the ship's side. This operation tended to equalize the hull's pressure distribution. The corresponding reduction in required power was quite significant.

INSTRUMENTATION OF COMPONENTS OF MARINE POWER PLANTS

Researcher: Midshipmen 1/C Grant B. Thornton and Daniel Vortherms

Adviser: Associate Professor William A. Barr

The automatically-controlled marine steam power-plant in the laboratory spaces under Rickover Hall requires more instrumentation to measure the thermodynamic properties and mass flow rates through the individual pieces of equipment in order to obtain accurate studies of each component. The research project is to specify the instrumentation required.

NEUTRON ACTIVATION ANALYSIS OF TOBACCO SAMPLES

Researcher: Midshipman 1/C Spencer Tolis

Adviser: Associate Professor Martin Nelson

A study has been made on the effect of fast neutrons on various tobacco samples by using the USNA fast neutron generator. The purpose of the study is to see if silicon, known to be present in tobacco, can be sufficiently activated by fast neutrons, such that the resulting γ -rays emitted can be counted and detected by a NA I detector and multi-channel analyzer.

The first part of the study involved a literature search. The second part of the study involved the actual irradiation of the tobacco. To date, no positive results have been obtained. This suggests the possibility that a more sensitive γ detector, such as a Geli/detector is needed in order to detect the presence of Silicon in tobacco.



BHATTACHARYYA, Rameswar, Professor, Dynamics of Marine Vehicles.
New York: Wiley Series on Ocean Engineering, 1978.

The book is primarily intended as a textbook for a first course in seakeeping, and emphasis is therefore placed on the fundamentals of the subject matter. Through the use of numerous figures, tables, and the solution of exemplary problems, this book will help the reader in understanding the basic principles and allow him to follow the methods outlined in the text. The chapters have been arranged to present a sequence of the physical phenomena, e.g. simple waves, linearized motion, non-linear motion, coupled motion, the seaway, motions in an irregular seaway, etc. This book has been written also with the idea that a design engineer will have ample opportunity to follow the proper steps to improve the hull form for his specific design.

BOCK, Arthur E., Professor, Eugene L. KEATING, Assistant Professor (Mechanical Engineering), the late Professor Robert M. JOHNSON (Mechanical Engineering), and Rear Admiral William A. BROCKETT, USN, (Ret.), Elements of Applied Thermodynamics. Revised Fourth Edition, Annapolis: United States Naval Institute, 1978.

The objective of this textbook is to present certain fundamental concepts of engineering thermodynamics to the undergraduate student, either engineering or non-engineering oriented, in a clear, concise manner, and to give those concepts real physical significance by early and frequent application to actual thermodynamic equipments, their processes and cycles.

In support of the objective, the chapters are arranged to first present various systems of engineering measurement, and then to emphasize the similarities and differences of the two measurement systems used throughout the text: the English Engineers' System and the International System (SI). There follows an introduction to the various engineering fluids and their properties, the kinds of energies to be emphasized, the non-flow processes and associated systems, and then a general statement for the development of the Fixed Law of Thermodynamics embodied in the Steady Flow Energy Equation. An immediate application of theory to an actual machine is made through a study of the air compressors.

The Second Law of Thermodynamics and other fundamental cyclic concepts are then presented and applied to important ideal cycles and actual systems. Subsequently, operating principles and performance-criteria of major components in the steam power cycle, the refrigeration cycle and the gas turbine power cycle, with particular emphasis

on the steam and gas turbine are presented. In addition, the text presents certain elements of incompressible and compressible fluid flow, heat transfer, air conditioning and the combustion of fuel-air mixtures.

Appendices A through E are included to compare various engineering systems of dimensions and units, to present thermodynamic properties of dichloro-difluoromethane and properties of air and low pressures, and to develop generalized relationships from compressible gas nozzle flow, Brayton cycle maximum work related to pressure ratio and diesel and dual-combustion-cycle thermal efficiencies expressed in pertinent cycle ratios.

CALISAL, Sander M., Assistant Professor, "An Attempt to Detect the Importance of Turbulent Boundary Layer in Ship Wave Resistance." U.S.N.A. Report, June 1979.

The Reynolds number of a ship model is increased artificially by using a flat plate loading the model. The turbulence level of the flat plate boundary layer is also altered. A decrease in the calculated wave resistance and measured residual resistance is observed within the Froude number range, $L < Fr < 4$. The results indicate a viscous-wave resistance interaction which can be formulated in terms of the visco-elastic properties of a turbulent flow. A possible formulation using this procedure is also indicated.

CALISAL, Sander M., Assistant Professor, "An Experimental Study of Turbulent Boundary Layer with Slit Suction." Ocean Engineering, 5 (December 1978), 325-345.

Experiments are performed on a flat plate with a transverse suction slit in the Reynolds number range $5 \times 10^5 < Re < 1.1 \times 10^6$. Mean Velocity profiles. RMS values are measured with hot wire anemometry. Friction velocity is numerically calculated. The experiments showed that a classical boundary layer parameter α is related to the suction coefficient S_c with an equation of the form:

$$\ln \left(\frac{\alpha_{\text{with suction}}}{\alpha_{\text{without suction}}} \right) = A \cdot S_c + B \text{ for } 0 < S_c < 3 \text{ and } y^* > 10$$

The value of A seems to depend strongly on the relative location with respect to suction slit and possibly weakly on Reynolds number.

DAWSON, Thomas H., Associate Professor, "Continuum Description of Hysteresis Damping of Vibrations," International Journal of Solids and Structures, 14 (1978), 457-464.

A continuum description of hysteresis damping of vibrations is constructed based on the assumption that the hysteresis in the elastic response is due to the occurrence of small plastic strains below the over-all elastic limit of the material. The associated constitutive law describing elasticity with hysteresis is developed assuming the plastic strain rate for loading is dependent only on the stress and stress rate. It is shown that the constitutive law so developed yields the well-known Kimball-Lovell quadratic damping law for sufficiently low stress levels and that it provides additional terms for describing damping when higher stress levels are involved.

The theory is applied to the free torsional vibration of wires and is shown to yield exponential amplitude decay for low stress levels. At higher stresses, the decay is found to be greater than this limiting exponential form in accordance with long standing experience. Detailed theoretical results are compared with measurements of the torsional response of a soft copper wire and the description is found to be excellent.

DAWSON, Thomas H., Associate Professor, "Wave Propagation over a Deformable Sea Floor," Ocean Engineering, 5 (1978) 227-234.

The propagation of water waves over a deformable bottom is examined theoretically for the case where the soil beneath the water is regarded as an elastic solid. Equations are given for calculating wave speeds, soil displacements and stresses, and water motion and pressure. Detailed wave-speed solutions are worked out for the case of an incompressible soil. The effects of soil inertia are included in the analysis, and it is shown that such effects cannot generally be ignored without committing serious error.

GULARTE, Ronald C., Assistant Professor, co-author, "Erosion of Cohesive Sediment as a Rate Process," Journal of the GEO Technical Engineering Division, Proceedings of the American Society of Civil Engineers, 105, (May 1979), 673-676.

There is an extensive body of literature dealing with the erodibility of cohesive soils, and only a brief review of aspects touching on the present investigation will be attempted. The new experimental work to be presented has all been with an illitic clay (Grundite).

It is well known, even to the layman, that sediments exposed to fluid stressing are eroded. The average stress imposed on the soil surface can be related to the velocity of flow, and velocity and stress are often used interchangeably in erosion studies. According to Partheniades and Paaswell (1970) erosion of cohesive sediments is controlled by the bed-shear stress. It is only logical then that a relationship would be sought between the bed-shear stress that initiates erosion and the macroscopic shear strength of the sediment as measured by a vane shear or cone penetrometer. However, for soft soils the results have indicated at best a poor correlation, and Partheniades and Paaswell (1970) concluded that there is no definite correlation. Moreover, they suggest that the so-called critical shear stress is constant and essentially independent of macroscopic shear strength and that erosion is controlled by the strength of individual bonds.

Descriptions of surface erosion by Partheniades and Paaswell (1970) and soil creep by Mitchell (1976) suggest fundamental similarities in the phenomena. Recently, data have been published that indicate rate process theory may be applicable to the erosion of cohesive sediments.

Christensen and Das (1974) tested clay linings in a brass tube; the clay was eroded by controlling flow through the tube. Computed experimental activation energies were approx 15 kcal/mole for both Kaolinite and Grundite and the number of flow units per unit area was estimated to be of the order of $5 \times 10^5 \text{ cm}^{-2}$; these values are lower than those reported for creep (1976). Raudkivi and Hutchison (1974) published a paper describing a flume study of Kaolinite erosion. They observed a temperature effect on erosion rate and used rate process theory in their analysis although not in the same sense as Christensen and Das (1974).

NELSON, Martin E., Associate Professor, Eugene L. KEATING, Assistant Professor, et al., "Hydrogen Production from Nuclear Fission Product Waste Heat and Use in Gas Turbines," Proceedings of the 2nd World Hydrogen Conference, Zurich, Switzerland, 1, (August 1978), 77-108.

An analysis has been made on the feasibility of producing hydrogen using fission product waste heat and its subsequent combustion in gas turbines. The work has been performed in three distinct phases.

In the first phase, a system using radioactive waste heat has been designed, which produces saturated steam. This steam is sent through a turbogenerator to produce electricity. The electrical power output of this system has been calculated as a function of fission-product decay-time, solidified form of fission products, as well as numerous other parameters.

In the second phase, the electrical energy produced is used to electrolyze water, which in turn produces hydrogen. The amount of hydrogen produced (lb/hr) has been calculated for varying electrical inputs, electrolyzer efficiencies, and feedwater temperatures. This hydrogen is then assumed to be liquified and stored. Finally, the third phase considers the burning of this hydrogen in a standard marine gas turbine.

NEHRLING, Bruce C., Assistant Professor, "An Associative Ring Structure for Alleviating Spatial Interferences," Proceedings of the International Conference on Computer Applications in the Automation of Shipyard Operation (ICCAS-79). Glasgow, Scotland: North Holland Publishing Co., Amsterdam, June 1979, pp. 245-250.

One aspect of shipbuilding which deserves extensive computer-assisted investigation but has been largely ignored is the problem of spatial interferences. Spatial interferences occur whenever two or more objects attempt to occupy the same space at the same time. The extremely complex nature of the various systems which make up a ship's interior ensures that this situation has a high probability of occurring. Such occurrences could be minimized if an associative ring-structure in conjunction with a small repertory of user-controlled functions for manipulating the ship's internal components was available during the design process. This data structure could help in determining if any spatial interferences existed and then assist in resolving them. It could help to ensure the compatibility of extensively outfitted hull-models. It could also be used when determining how accessible a given piece of equipment would be for maintenance or replacement. This paper examines the concept, formulation and potential applications of such an

associative ring-structure. In particular, this paper describes computer software that could be developed for configuring and manipulating the topology of a ship's internal systems.

RICHARD, Clyde C., Assistant Professor, "Modeling of Circulating Water Systems." Power Engineering, 83, (January 1979), 47-49.

The reliability and availability of the main steam condenser are of utmost importance in maintaining good power plant performance. Leaking condenser tubes jeopardize good condensate water quality, and lead to serious operating problems. If leaking progresses beyond specified limits, a plant derate or shutdown results while tubes are plugged. With the high outage and derate costs of today's large units, tube plugging can become a very expensive operation.

There are a host of problems that plague steam surface condensers. Ammonia attack, tube vibration, and steam cutting are not uncommon on the steam side of the tubes. The water side is also susceptible to problems with poor tube-to-tube-sheet seals, corrosion-erosion attack, and inlet-end erosion being found in many condensers.

Good waterside heat transfer requires substantially high velocities in the condenser tubes. Material limitations, however, limit tube velocities to about 6-7 fps for copper alloy tubes to about 10 fps for materials such as stainless steel and titanium. In all cases it is essential to provide smooth flow into the tubes with little or no rotation in order to ensure that erosion will not take place in the tube inlets before the flow can become stabilized. Excessive turbulence, whether it results from the circulating water pumps, inlet piping configuration or waterbox design, can be disastrous to tube life.

This paper presents the results of hydraulic studies conducted to determine the potential for inlet and erosion in a power plant condenser. The modeling program is discussed and typical data shown for a series of hydraulic tests.

WIGGINS, Peter F., Professor, "Coal Analytical Assembly Using Capture Gamma Rays from Accelerator Neutrons," Transactions of the American Nuclear Society, 30, (November 1979), 142.

Analysis of coal by measuring decay gamma rays following neutron absorption has been widely used. More recently, analysis for sulfur using capture gamma rays has received attention. The promptness of the capture gamma (γ) rays, their higher energy (hence, more penetration of container walls and a larger sample size), and their possible usefulness for many elements that do not respond to the decay method have led to their use in monitoring of process streams of plants converting coal to gas and oil. Possible neutron sources for analytical units on process streams include ^{252}Cf and accelerators. As part of the coal instrumentation program at Argonne National Laboratory, a Texas Nuclear accelerator was adapted to an assembly of coal. The unit also features a neutron reflector of the Be blocks in a 20-mile Al, with a Ge(Li) gamma detector.

The Be-reflection assembly with an accelerator neutron source is experimentally useful for capture gamma measurements with simulated streams of coal, and, presumably, with coal and processing chemicals and catalysts. Because of its high-temperature properties and useful calibration lines, Be may be appropriate for a plant unit. A tritium target would give more neutrons, and at a higher energy would provide additional gamma rays of analytical value. Such accelerator analytical units may be attractive for industrial plants because of convenience in operations. Overall, the research is favorable to use of an accelerator and the capture gamma technique for on-stream analysis for planned coal conversion plants.

WIGGINS, Peter F., Professor, et al, "Evaluation of Dosimetry Film by Neutron Activation and X-Ray Fluorescence," Journal of Nuclear Science and Technology, 16, (February 1979), 89-91.

Photographic film was exposed to γ -rays from ^{226}Ra and ^{60}Co to levels of 5 mR to 5,000 R. Measurements to the Ag in the developed films by both (a) activation with neutrons from ^{252}Cf and counting ^{110}Ag (half life 24.4 sec) and (b) X-ray fluorescence correlated with the known exposures. In the lower ranges conventional optical density measurements were made, and the correlation with the activation and X-ray methods was good.

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SUMMARY OF RESEARCH ACTIVITIES, ACADEMIC DEPARTMENTS, 1979-1980--ETC(U)

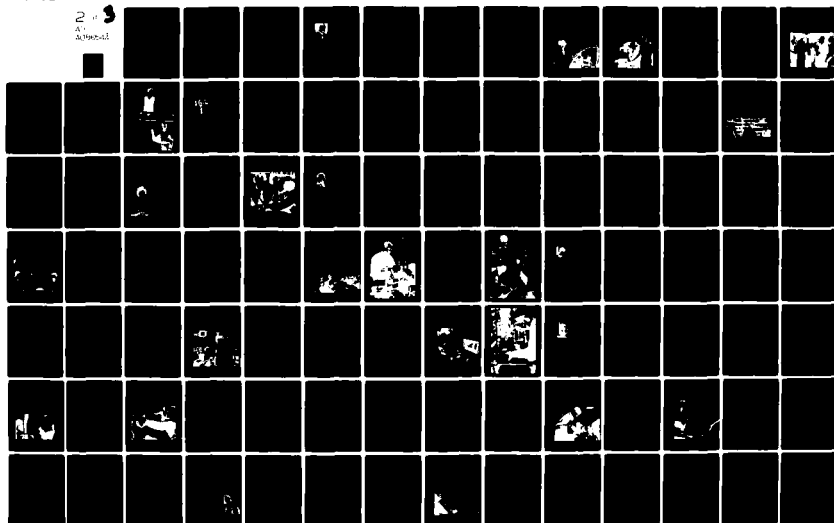
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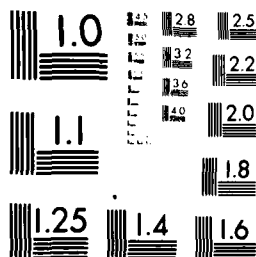
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MICROCOPY RESOLUTION TEST CHART
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PRESENTATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

CALISAL, Sander M., Assistant Professor, "Experimental Study of Initial Acceleration Effects." First International Congress of International Maritime Association of the East Mediterranean, Istanbul, Turkey, 25-29 September 1978.

CALISAL, Sander M., Assistant Professor, Lectures at Istanbul Technical University, Istanbul, Turkey:

"Computerized Design of Midship Section" 2 series, 8-15 June 1978;
"Ship Vibration Formulation for Computer Solution", 22 June 1978;
"Effect of Ship Initial Acceleration on Wave Survey Methods", 29 June 1978;
"Effect of Suction on Ship Boundary Layer Parameters", 6 July 1978.

HOUSEMAN, Douglas and Larry D. LINN, Midshipmen 1/C, "An Experimental Investigation of the Hybrid Ship Concept: HYWAS, "Chesapeake Section of SNAME, Washington, D.C., April 1979, (Paper was awarded the best student paper prize for the section for 1979).

JOHNSON, Bruce, Professor, "A Note on the Calculation of Significant Wave Height", 14th ITTC, The Hague, September 1978.

JOHNSON, Bruce, Professor, "Progress in the Development of Irregular Wave Testing Techniques for Surface Ships." SEAHAC Annual Meeting, San Diego, 22 March 1979.

McCORMICK, Michael E., Professor, "Cohesive Erosion As A Rate Process." 1979 Spring Meeting of the American Geophysical Union, Washington, D.C., 1 June 1979.

McCORMICK, Michael E., Professor, "Scouring of Cohesive Material As A Rate Process." Civil Engineering, Ocean IV Conference, San Francisco, 10-12 September 1979.

PRESENTATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

NEHRLING, Bruce C., Assistant Professor, "An Associative Ring Structure for Alleviating Spatial Interferences." Third International Conference on Computer Applications in the Automation of Shipyard Operation (ICCAS-79), Glasgow, Scotland, 18-21 June 1979.

NELSON, Martin E., Associate Professor; Clyde C. RICHARD, Assistant Professor; and Maida SAARLAS, Associate Professor, "Problems Encountered in Developing and Applying Data to Power Plant Reliability Model-Consultant's Viewpoint," 1979 Reliability Conference for the Electric Power Industry, Miami Beach, April 1979.

RICHARD, Clyde C., Assistant Professor; Martin E. NELSON, Associate Professor; and Maida SAARLAS, Associate Professor, "Problems Encountered in Developing and Applying Data to Power Plant Reliability Models-A Consultant's Viewpoint," 1979 Reliability Conference for the Electric Power Industry, Miami Beach, Florida, 19-20 April 1979.

RICHARD, Clyde C., Assistant Professor and Robert F. LATHAM, Associate Professor, "The Classroom Design of a COGAS Plant by Naval Systems Engineering Students", Israel Gas Turbine Congress, Haifa, Israel, 9-11 July 1979.

WIGGINS, Peter F., Professor, "Coal Analytical Assembly Using Capture Gamma Rays from Accelerator Neutrons," Transactions of the American Nuclear Society. 30, (November 1978), 142.

PRESENTATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

The following papers were presented by midshipmen majors in Naval Systems Engineering at the ANS Student Regional Conference, College Park, Maryland, 23 March 1979:

DELANCY, Kevin, Midshipman 1/C, "Soviet Nuclear Power Reactor Safety" (Paper won First Place award).

DOTY, Charles, Midshipman 1/C, "Safety Problems of a Liquid Metal Fast-Breeder Reactor" (Paper won Second Place award).

HUDDLESTON, Robert, Midshipman 1/C, "Fusion: The Problems it Poses to Modern Technology."

IKSTROMS, Ivars, Midshipman 1/C, "The Inertial Confinement Fusion Reactor: Some Component Design Considerations" (Paper won Second Place award).

LILLO, Ricardo P., Midshipman 1/C, "A Survey of Research Effects of Low-Level Radiation" (Paper won Second Place award).

MAU, Roger G., Midshipman 1/C, "Waste Management Alternatives" (Paper won \$50 Award from local ANS Washington Section as best college-area paper as well as Second Place award from conference judges).

MEADER, William H., Midshipman 1/C, "Breeder Reactors: Can We Do Without Them?" (Paper won First Place award).

SWENSON, Dana, Midshipman 1/C, " 'Seabrook vs the Clams': The Fight Goes On."

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

Professor Charles F. Olsen, Chairman



The Weapons and Systems Engineering Department provides and maintains an environment in which research activities contributing to the professional growth of the faculty and outstanding midshipmen flourish. Such research, in addition to keeping both faculty and midshipmen abreast of today's rapidly advancing technology, ultimately improves the academic environment by providing examples of, and solutions to, existing problems. Where research is based on problems posed by the U.S. Navy, the association causes the academic environment to be more relevant to the professional development of midshipmen.

Faculty research is regularly undertaken by nearly all civilian members of the Weapons and Systems Engineering Department and on occasion by some military members as well. Funding for research activities is available from several sources, including grants or contracts from various federal agencies as well as funding support from within the Naval Academy. Current contracts have been made by faculty members with both the Naval Surface Weapons Center and the Naval Air Development Center. Excellent faculty and midshipmen research relations have additionally been established with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory.

LASER-TRIGGERING OF NRL VEBA PARTICLE ACCELERATOR

Researcher: Major Jerry R. Bettis, USAF

Sponsor: Naval Research Laboratory, Washington, D.C.

This research is designed to provide nanosecond accuracy-subnanosecond precision switching of a kilogauss magnetron with a 0.1 megajoule particle-accelerator. These two events must occur simultaneously to obtain a properly focused beam. The scheme involves initiation of conduction in an overstressed voltage gap by insertion of a 0.5 gigawatt laser pulse into the gap. The electrode configuration has been finalized and should soon be manufactured. The laser specifications and beam-handling optics requirements have been produced and are under order. The system will be assembled and tested this summer. Switching response will be investigated as a function of fill gas, laser power, percent of the self-breakdown voltage to which the gap is charged, and focusing arrangement. The laser beam will be split in an attempt to initiate several conduction channels simultaneously to reduce inductance, hence risetime.

A COMPARATIVE STUDY OF FIRE CONTROL TARGET STATE ESTIMATORS

Researcher: Assistant Professor Robert DeMoyer, Jr.

Sponsor: Naval Surface Weapons Center, Dahlgren Laboratory

Anti-aircraft gun fire-control computers contain an algorithm to project target position ahead in time. This is necessary to account for projectile time of flight to compute gun lead-angles. For this purpose, time series of measurements are available from radar and inertial references. The customary way to process large quantities of such error-corrupted measurements is to implement a real-time digital Kalman filter. However, present computers are not fast enough to implement an optimal, fully-coupled filter.

The purpose of this research is to investigate various sub-optimal decoupled approximations of the filter which can be implemented in real time as required. Attention is centered on the use of rate gyros versus position gyros and on decoupling in fixed inertial coordinates versus rotating non-inertial coordinates.

Based upon the above choices, different sub-optimal configurations are simulated, and their relative accuracy is ascertained by use of a Kalman filter "truth model". Graphical results consist of computer-generated error ellipses centered at the target.

SPONSORED RESEARCH

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

**A GENERAL PURPOSE FLUID LOGIC/FLUID POWERED GRIPPING MECHANISM
FOR TELEOPERATORS AND ROBOTS**

Researcher: Assistant Professor Kenneth A. Knowles

Sponsor: Naval Academy Research Council

The objective of this project is to develop and construct a prototype general-purpose end effector for use with underwater manipulators (teleoperators and robots). The end effector is to be entirely fluid-powered and is to contain fluid logic controls to automate reflexive sequences of motions.

This project will proceed along the following sequence of investigations:

- a. Determination of a required subset of standard end effector motions and/or tasks.
- b. Development of a minimized general-purpose end effector configuration which will be capable of effecting the subset of motions/tasks.
- c. Determination of the sequences of (reflexive) motions which would be suitable for automation.
- d. Development of the prototype fluid logic which will be capable of effecting the reflex motions.
- e. Construction of the prototype end effector, including the reflex logic control, which will be capable of effecting the required motions/tasks/reflexes.
- f. Evaluation of the suitability of the chosen method of control.

Parts a through d are essentially complete. Part e is presently in progress.

SENSITIVITY ANALYSIS OF A RATE SENSOR WITH OBSERVER

Researcher: Associate Professor E. Eugene Mitchell

Sponsor: Naval Air Development Center

The Automatic Controls Division of the Naval Air Development Center, (NADC) of Warminster, Pennsylvania, is currently investigating the use of the Model 8160 rate sensor offered by the inertial division of Systron Donner, Concord, California. This rate sensor appears to have the potential for reduced maintenance cost over current models; however, its output response has zero transmissibility at zero frequency and NADC wanted to determine if this could be altered through use of a filter.

SPONSORED RESEARCH

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

An observer was designed to function as a state estimator for the rate sensor. Once the system states were available, the output of the observer was modeled after a desirable response. The resulting observer output performance exceeded expectations.

This report is a sensitivity study of the effect of all the rate sensor and observer parameters on the generated observer output.

A DYNAMIC MODEL OF A PROPOSED MARINE COGAS PROPULSION SYSTEM

Researcher: Assistant Professor Jerry W. Watts

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

The purpose of this research is to develop a digital computer model of a marine COGAS (combined gas turbine and steam turbine) propulsion system. This model will provide for heat storage in the heat exchangers of the waste heat recovery unit so that the power up and power down transients can be adequately modeled. The model will also allow for incipient boiling at various points in the heat exchangers. The model will be used to provide temperature and pressure data and steam turbine power contributions during power transients.

CONTROLLABLE REVERSIBLE PITCH

Researcher: Assistant Professor Jerry W. Watts

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

DTNSRDC is involved in a project to improve fuel economy on gas turbine driven ships by scheduling the pitch of the CRP (controllable, reversible pitch) propellers. This research will examine various control methods which will perform the necessary scheduling of the propeller pitch dependent upon ship speed, shaft speed, mode of operation and ship hull fouling factor.

SPONSORED RESEARCH

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

MICROPROCESSOR CONTROL OF LOW SPEED VSTOL FLIGHT

Researcher: Midshipman 1/C Robert V. Walters

Adviser: Associate Professor E. Eugene Mitchell, Assistant Professor
Kenneth A. Knowles, CDR M. D. Hewett, USN (Aerospace Engineering)

Sponsor: Trident Scholar Program

The Harrier aircraft and its SAS (stability augmentation system) have been mathematically modeled and simulated on DTSS. The simulation results are the same as found by NADC Warminster and Calspan Corporation.

The model is currently being simulated on the hybrid computer to facilitate the control system design and study. In addition, it is quite simple to interface a microcomputer to the hybrid computer.

Under proper conditions of sideslip, the Harrier aircraft is unstable. The model simulates this condition. The next step is to implement a microcomputer control algorithm to correct the instability.



MAGNITUDE SCALING AS A LINEAR TRANSFORMATION

Researcher: Assistant Professor C. George Brockus

The problem of scaling systems in state space equation form, to permit their programming on analog computers, was investigated as an application of Linear Transformations between state variables.

Various conditions were seen to suggest the need for time scaling, as ratios of magnitude scaling coefficients affect only off-diagonal terms in the system matrix.

The choices for scaling coefficients were seen to be strongly dependent, but once these dependencies have been carefully formulated, an optimal choice can be made for the ratios of those coefficients.

Investigation of the initial conditions and inputs to the system is necessary to permit the selection of magnitudes for the scale factors.



RESEARCH COURSE PROJECTS WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

MICROPROCESSOR CONTROL SYSTEMS

Researchers: Midshipmen 1/C Robert E. L. Bond, Francisco J. Montero,
Britt C. Skogstand, Ralph E. Spaulding, James A. Stokes

Advisers: Associate Professor E. Eugene Mitchell and Assistant Professor
C. George Brockus

The microcomputer-based control systems developed the preceding year formed the basis for these projects. The midshipmen primarily gained experience with these systems to enable them to continue into design projects second semester.

Some utility routines were developed to enhance the operation of the systems. The hardware interface and software handlers were developed for a paper tape reader to aid in the process of downloading programs from the cross assembler on DTSS.

Some of the hardware and software was developed to enable the controller to be used to drive an XY table for a drill press. Software was developed to enable the controllers to interface a music synthesizer through an output port.

An analysis of the instruction set of the INTEL 8080 was undertaken to permit a FORTRAN development of a simulator for the system.

PUBLICATIONS

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

BETTIS, Jerry R., Major, USAF, et. al., "Scaling Laws in Laser-Induced Damage." National Bureau of Standards Special Publication: 10th Anniversary Issue of Laser-Induced Damage Conference, June 1979.

The variation of the threshold for damage to optical components is considered as a function of several parameters. The threshold is seen to scale in a systematic manner with: spot size, pulse duration, surface roughness, refractive index, temperature of substrate, and hydroxyl content in thin films. Trade off studies can be made to find the most economically feasible finishing technique, given the operating conditions of the laser.

MITCHELL, E. Eugene, Associate Professor, "Sensitivity Analysis of a Rate Sensor With Observer," USNA Report EW-1-79, January 1979.

The Automatic Controls Division of the Naval Air Development Center, (NADC) of Warminster, Pennsylvania, is currently investigating the use of the Model 8160 rate sensor offered by the inertial division of Systron Donner, Concord, California. This rate sensor appears to have the potential for reduced maintenance cost over current models; however, its output response has zero transmissibility at zero frequency, and NADC wanted to determine if this could be altered through use of a filter.

An observer was designed to function as a state estimator for the rate sensor. Once the system states were available, the output of the observer was modeled after a desirable response. The resulting observer output performance exceeded expectations.

This report is a sensitivity study of the effect of all the rate sensor and observer parameters on the generated observer output.

OLSEN, Charles F., Professor, "Compensator Design Using the Frequency Domain Approach," Simulation, (May 1979), 167-172.

This paper presents an analytical technique for compensating a system in the frequency domain to meet phase margin and static error coefficient requirements at a specified gain crossover frequency. This paper concludes with a BASIC program which implements this technique.

PUBLICATIONS

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

WALTERS, Robert V., Midshipman 1/C, "Microprocessor Control of Low Speed VSTOL Flight," Trident Scholar Project Report Number 100, U. S. Naval Academy, Nimitz Library, Annapolis.

The Harrier aircraft and its SAS (stability augmentation system) have been mathematically modeled and simulated on DTSS. The simulation results are the same as found by NADC Warminster and Calspan Corporation. The model is currently being simulated on the hybrid computer to facilitate the control system design and study. In addition, it is quite simple to interface a microcomputer to the hybrid computer. Under proper conditions of sideslip, the Harrier aircraft is unstable. The model simulates this condition. The next step is to implement a micro-computer control algorithm to correct the instability.



PRESENTATIONS

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

BROCKUS, C. George, Assistant Professor, "Magnitude Scaling and Time Scaling for State-Space Descriptions of Systems," ASEE 87th Annual Meeting, Baton Rouge, Louisiana, 27 June 1979.

DEMOYER, Robert, Jr., Assistant Professor, "A Comparative Study of Target State Estimator Models," Tenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 26 April 1979.

DEMOYER, Robert, Jr., Assistant Professor, "Interactive Anti-Aircraft Fire Control Simulation: An Introduction to Hybrid Computation," ASEE 87th Annual Meeting, Baton Rouge, Louisiana, 27 June 1979.

WATTS, Jerry W., Assistant Professor, "Computer Simulation of a Proposed Marine COGAS Propulsion System," 1979 SAE Passenger Car Meeting, Dearborn, Michigan, 11-15 June 1979.

DIVISION OF
ENGLISH AND HISTORY



ENGLISH DEPARTMENT

Associate Professor Fred M. Fetrow, Chairman



Research and critical investigation by members of the faculty of the English Department enhance the quality and vitality of instruction in the classroom and the scholarly reputation of those involved and the Naval Academy they represent.

Academic Year 1978-1979 was an active and productive one for literary research and scholarly publication. Four sponsored projects of faculty members were undertaken: analyses of dramatic works that have been adapted from fictional form; a study of Geoffrey Chaucer's overriding philosophical

concerns; and two bibliographical studies, one of the American author Winston Churchill, and one of a newsletter on James Joyce's Finnegans Wake. A further sponsored project was that of a midshipman English major who, as a Trident Scholar, made a literary and historical study of the concept of chivalry as it has been adopted and applied by the military officer. Independent (non-funded) research, with nine projects in progress, included critical and biographical studies of British authors (Robert Burns, E. M. Forster, Christopher Marlowe, and T. S. Eliot); American writers (William Cullen Bryant and Leonard Gardner); an extended examination of Aaron Burr and the American literary imagination; and a study of the teaching of American literature in colleges and universities.

Six articles were published in scholarly journals, and The Annual Bibliography of English Language and Literature (Volume 50) included contributions of a member of the English faculty. Five papers were presented at meetings of professional societies.

A WAKE NEWSLITTER: AN ANNOTATED BIBLIOGRAPHY

Researcher: Lieutenant Commander John Harty, USNR

Sponsor: Naval Academy Research Council

The purpose of this project is to create an annotated bibliography of Dr. Clive Hart's newsletter A Wake Newslitter (published in England) which contains criticism of James Joyce's Finnegans Wake. The newsletter has been issued quarterly for the past fifteen years. No such annotated bibliography exists at this time. The experience of the researcher in abstracting articles on Shakespeare and other writers for Abstracts of English Studies, as well as several graduate courses taken on the works of Joyce, should prove helpful in the pursuit of this project.

GEOFFREY CHAUCER'S PHILOSOPHICAL POETICS IN THE CANTERBURY TALES

Researcher: Assistant Professor John N. Hill

Sponsor: Naval Academy Research Council

The objective of this project is a badly-needed scholarly study addressing Chaucer's overriding philosophical concerns in The Canterbury Tales. Scholars who attempt an overview of The Canterbury Tales usually try to fit them to particular moral schemes--as though the Tales form a unitary whole expressing a resolved viewpoint. This approach fails for two reasons: (1) the fragmentary nature of the collection; (2) Chaucer's philosophical concerns. The latter is a crucial matter in understanding the Tales for what they are: a series of brilliant explorations into the truths of human experience and passion, on one level, and the adequacy of various approximations of order on all levels (e.g. marital, ethical, societal, and cosmic). The key is the word "exploratory"; Chaucer maintains a uniquely troublesome relationship vis-à-vis his work and his readers. He puts us in his place: we must struggle, as he has, with all of the perspectives on love and will, justice and order, intent and effect, high seriousness and playfulness that appear in the Tales. What perplexes him, he leaves for us--resolving nothing. A failure to recognize these points, along with a lack of research on Chaucer's philosophical vocabulary and his philosophical use of rhetorical concepts, has led to a scholarly impasse in studies devoted to The Canterbury Tales. Therefore, the proposed project should contribute to a major rethinking of the literary project Chaucer undertook almost 500 years ago.

ADAPTED FOR THE STAGE: FICTION INTO DRAMA

Researcher: Professor Michael Jasperison

Sponsor: Naval Academy Research Council

The purpose of this project is to analyze a number of dramatic works adapted from the original fictional form in order to illuminate the problems encountered by the playwright in adapting material from fiction into a play that "works" on the stage. Emphasis is placed on defining the nature of "compression" as the process by which narrative fiction is transformed into an effective script for the theater, and examining the process of "compression" as it appears to be used in five plays adapted from fiction. Upon completion of the investigation, an article or monograph will be written summarizing procedures involved in the research and conclusions reached. A primary objective is to provide students with an understanding of how the playwright fashions dramatic literature with a conscious awareness of theatrical effectiveness.

Five plays and their fictional counterparts are to be examined in detail, with attention to the processes of "compression" evident in all five plays. Previous experience with directing student productions of the five plays, which involved close examination of the original fictional sources, has provided abundant groundwork for pursuing the project. Additional material, including literary criticism and theater reviews, is available for examination.

Considerable work on the project has already been accomplished in examining the fiction and the dramatic literature. Based on that work, a lecture on the preliminary stages of the project was presented to senior English majors in the second semester of this academic year, at the request of the instructor of the seminar in literary criticism.

A BIBLIOGRAPHY OF WINSTON CHURCHILL

Researcher: Major Eric N. Steinbaugh, USMC

Sponsor: Naval Academy Research Council

The objective of this project is to compile an annotated bibliography of works by and works about Winston Churchill (1871-1947), the American novelist. A methodical search of bibliographies, catalogues, indexes, and checklists is required to discover pertinent material written by and about Churchill. These materials must then be located and copies obtained of those which are not available in the immediate vicinity. The materials must be read and bibliographic cards with annotations must be composed. The final typescript will be developed from the cards.

Churchill graduated from the Naval Academy in 1894, was editor of Cosmopolitan, wrote some of the best-selling historical novels of his time, was twice elected to a seat in the New Hampshire Legislature, and narrowly lost in the 1906 New Hampshire gubernatorial race. Among his friends and acquaintances were Upton Sinclair, Jack London, Sir Winston Spencer Churchill, President Theodore Roosevelt and President Woodrow Wilson, who used Churchill's New Hampshire home as a summer White House.

Eight of Churchill's novels were best-sellers between 1899 and 1915; five were the number one best-sellers of their years. In 1924, the International Book Review placed him fourth on a list of the greatest writers since 1900. Asa Dickinson listed four of his books in One Thousand Best Books in 1931.

Clearly, Churchill is a figure worthy of scholarly regard and yet, except for the predictable scattered flurry of articles following his death in 1947, he has been overlooked. This inattention may be due, in part, to the lack of readily accessible background material on Churchill. A bibliography of works by Churchill and works about Churchill is needed to help fill this void.

CHIVALRY AND THE MILITARY OFFICER: AN HISTORICAL AND LITERARY INQUIRY

Researcher: Midshipman 1/C Jeffrey E. McFadden

Adviser: Professor Wilson L. Heflin

Sponsor: Trident Scholar Program

This study utilizes pertinent works of literature and biography in tracing the historical development of the concept of chivalry as it has been adopted and applied by the military officer. It begins with the fourteenth century, when the concept of the "gentleman officer" first appears. In two long chapters, it focuses on two major figures who stand as chivalric exemplars: Sir Gawain, in Arthurian literature, and Vice Admiral Horatio Lord Nelson, as leader in the Royal Navy of Great Britain. The final chapter of the study concentrates on aspects of chivalry that relate to naval officers and the naval service today. The study also includes a long glossary of chivalric terms.

FAT CITY AND THE CYCLE OF DESPAIR

Researcher: Assistant Professor Neil Berman

Unlike many other recent sports novels, in which the play-attitude is thwarted by professionalism and commercialization, in Fat City it is the condition of life itself which is most reductive. Leonard Gardner's novel is an example of the new naturalism in American fiction, a book whose most striking precursor is Crane's Maggie rather than the robust fictions of Hemingway. Not only is boxing unplayful in Fat City, but even the potential for play is destroyed by a confining, deterministic environment. Play exists only as a grim illusion in the world of this novel. Although Fat City follows the cycle of the seasons, its rhythm never leads to mythic renewal. Would-be players never attain the play-attitude. Their basic ambivalence, or even hostility, toward the play-sphere makes of them instruments of ironic determinism. Thus spring and the enticement back into training only renew the frustrating quest for escape and continue the cycle of despair.

BURNS' "DEATH AND DOCTOR HORNBOOK" AND THE FORMS OF FORMAL VERSE SATIRE

Researcher: Associate Professor John P. Boatman

Unlike previous commentators, who find little in this early Burns' poem but witty topical hits and scathing local satire, the present investigator finds (1) that the form of Burns' poem is perhaps the clearest and almost unique example of an original formal verse satire available in 18th century British poetry--at a time when "not one of the half dozen or so great English satires" was "a formal verse satire"; (2) that Burns' form derives from traditional Scotch interest in the example and teaching on satire from among the forerunners of the first formal French satires of DuBellay and R gnier, whose example and teaching was largely ignored among English neo-classic poets, with the possible exception of Dryden; and (3) that Burns' poem fully embodies the traditional minimum essentials of classic verse satire as transmitted through French example and doctrine: namely, a combative interlocutor (here the poet as urbane Scots townsman), an Adversarius (here Death in person), a lightly sketched-in setting (here a public road between midnight and dawn), a quasi-dramatic frame (here the speaker's chance encounter with Death, who reports on Dr. Hornbook's artful malpractice that fills the local graveyards with an abundance that in time promises to deprive Death of his natural function), and a thesis to be argued (here the common conservative belief of the age that any abuse of common sense leads only to the injury of mankind).

BURNS' "LIBERTY AND LOVE--A CANTATA" ("THE JOLLY BEGGARS") AND THE GREEN WORLD OF VAGABOND TRADITION

Researcher: Associate Professor John P. Boatman

Long years of marked distaste for the realistic portrayal of disreputable low-life celebrated in this, the longest of Burns' poems, has disabled many readers from making a just appreciation of this poem. To rectify this view, if possible, the present investigator addresses himself to supporting four propositions concerning the form, meaning, and purpose of this masterpiece among Burns' poems: (1) This poem is a notable member of a long line of festive works that celebrate the uninhibited, recreative, amoral carnival spirit of man from ancient times to the present, a spirit represented by such exemplars as the ancient fertility rituals and the modern Mardi Gras, by Aristophanes as well as Chaucer, Rabelais, Cervantes, Shakespeare, and Dickens. (2) The cantata form (in its original meaning) imposes artistic control upon the seemingly episodic and haphazard structure of the poem, a form which speaks eloquently the poet's artistic purpose. (3) The poet deliberately exploits his mixture of English and Scottish diction to represent the two poles of his imagined world of values: (a) English--to represent the explicit world of logical discourse, of abstraction and limit, associated with the inhibitions and oppressions of respectable society, and (b) Scottish--to represent the intuitive native values of intimate fellowship, equality, and compassion--all rejected by the respectable world of official society. (4) The poem ultimately celebrates in a sort of poetic eucharist the regenerative power of poetry to transmute the bread and wine of deadened values of official society into the creative "green world" of regenerative values that foster fellowship, love, and a moral concern for a truly reinvigorated life.

FAUSTUS AND OTHERS AMONG THE NIGHTINGALES

Researcher: Professor Wilson L. Heflin

During 1918 T. S. Eliot was extensively exploring the works of Elizabethan dramatists and writing critical articles about them. He was also composing poetry of a sort that often perplexed his readers. One such poem, published in the Little Review that year, was "Sweeney Among the Nightingales." In 1919 Eliot published "Marlowe," a short essay that is concerned mostly with the Elizabethan's "deliberate and conscious" workmanship, with his "mighty line," and with Eliot's interest

in the discovery that Marlowe, too, was a "partly synthetic" poet, one who made surprising thefts from the writings of Edmund Spenser. On the surface there seems to be little relationship between the essay on Marlowe and the Sweeney poem. Among the quotations from Marlowe cited by Eliot in his essay, however, there is a passage from Dido and Aeneas that is a startling clue to a real connection between poem and essay, and between poem and Marlowe's plays.

A careful rereading of Marlowe's dramas with the Sweeney poem at hand reveals that Eliot freely borrowed language and ideas from the Elizabethan playwright, especially from Doctor Faustus (the 1616 version), and from Tamburlaine, The Jew of Malta, and Dido and Aeneas. Young Possum's trick on his critics has long remained undetected. How these Marlovian echoes may affect our understanding of the difficult Sweeney poem, and whether that poem is related to some of the pre-1925 versions of Marlowe's death ("stabd to death by a bawdy Servingman," for example) are subjects of further exploration by the present researcher.

AARON BURR AND THE AMERICAN LITERARY IMAGINATION

Researcher: Assistant Professor Charles J. Nolan, Jr.

American writers have used the figure of Aaron Burr to express several of society's deepest fears. Though Burr was a complex personality, the popular conception of him as the cold-hearted murderer of Hamilton or as the detestable conspirator who tried to destroy the Union prevails. Such a view becomes commonplace after Burr's political enemies attack him as a Catiline, Cain, and sexual predator. Influenced by these pejorative images, American dramatists often repeat them in their works and add depictions of their own. But as the distance from the historical events in which Burr figured increases, the dramatic treatment of him becomes more positive. Overall, however, three images predominate--those of traitor, predator, and victim--the first two in the nineteenth century, the last in our time. Like the playwrights, American novelists and short story writers present a mixed picture of Burr. Here are the same three principal images of him along with equally appropriate analogues for them--those of Catiline, Lovelace, and Warwick. And once more the way in which Burr is portrayed shifts with time.

The Aaron Burr emerging from our literature, then, is a complex figure whom American authors employ for reasons not immediately apparent. In choosing to highlight the three major aspects of him that they did, they seem to use him as a vehicle to express society's fears and therefore in some way to purge them. Thus, in a nineteenth-century world that is apprehensive about both the dismemberment of the Union and the ruination of its women, the views our writers naturally emphasize are those of conspirator-traitor and predator. And in a twentieth-century society that feels threatened by the various forces that act to crush the individual, it is perhaps not unexpected that our authors also turn to the portrayal of Burr as victim. By choosing to focus upon these particular roles and by selecting for them the appropriate analogues of Catiline, Lovelace, and Warwick, they raise Burr to the level of American symbol. Thus he comes to represent aspects of American life that are profoundly disturbing--touches, that is, upon our most terrifying nightmares of societal chaos, of phallic plundering of our women, and of helpless victimization.

A PASSAGE TO SILENCE: THE PROSE STYLE OF E. M. FORSTER

Researcher: Assistant Professor Molly Tinsley

This book-length study offers an account, first of all of the ways in which stylistic criticism can best serve the work of literary art. It goes on to describe Forster's characteristic voice by noting syntactical recurrences in an assorted sample of his prose writing. Finally it demonstrates how this voice varies radically from novel to novel while still remaining within the "Forsterian parameters." These variations are related to the different worlds each novel creates, and they are given an objective dimension of quantitative data.

A PASSAGE TO SILENCE

Researcher: Assistant Professor Molly Tinsley

This essay examines Forster's attitude toward language and silence as it develops in his six novels. In his early work, "silence" has a positive tenor, suggesting passion, the ecstatic transcendence of time, experiences of vision which language is inadequate to express. By his later novels, "silence" is the characteristic of an objective universe unresponsive to man, even hostile. Language necessarily falsifies this universe, making it more orderly, glamorous, or exciting than it really is. It is this final, negative sense of "silence" which perhaps accounts for Forster's rejection of the novel as a viable medium for expression.

THE TEACHING OF AMERICAN LITERATURE IN COLLEGES AND UNIVERSITIES

Researcher: Associate Professor David O. Tomlinson

The purpose of this research was to find out how American literature survey courses are being taught in the nation's colleges and universities. A four-part questionnaire was prepared and sent to English department chairmen whose names were randomly picked from the 1978 MLA Directory. They were asked that they, or some members of their staffs actively involved in the teaching of American literature survey courses, complete the questionnaire. By the spring of 1979, the data was recorded and tabulated. Dr. Richard Pollak, Associate Director for Educational Development, took charge of the computerization of the data, utilizing the programs of the Statistical Package for the Social Sciences.

The instrument itself was a four-part questionnaire which sought general information about each school and the size of enrollments in American literature courses, about teaching goals and the methods employed in reaching those goals, about the selection and use of texts and materials, and about a philosophy of teaching.

Results of several aspects of the survey will be presented to the South Atlantic Modern Language Association Convention, and an article on the nature of survey courses in the community and junior colleges of the country will be published in Teaching English in the Two-Year College. This research was done in collaboration with Dr. Eltse Carter, Northern Virginia Community College.

WILLIAM CULLEN BRYANT, HIS LIFE AND WORK

Researcher: Associate Professor David O. Tomlinson

William Cullen Bryant was an enigma. He was a poet and quite a popular one in the mid-Nineteenth century; but though his work as a writer of verse brought him wide acclaim and great financial rewards, Bryant spent little of his adult life in poetic composition. Most of his time was spent as editor of a newspaper which Alexander Hamilton and his friends established in 1801, the New York Evening Post. Bryant edited the paper from 1829 until his death in 1878.

His attraction to language and its use showed itself quite early. At sixteen months of age, he was already repeating the alphabet from memory; and though he began writing verse at age seven, his first popular poem, one which was used in school commencements in Massachusetts and New Hampshire for many years, was not written until he was ten. The best-known of his poems, including "Thanatopsis," were written during his student years.

Bryant was trained as a lawyer, but he did not enjoy the work of that profession, so he decided to try to make a living as a writer in New York. At first, he edited a magazine; but then he landed a job on the New York Evening Post. When its editor, a man named William Coleman, died a few months later in 1829, Bryant became the new editor, remaining in that position until his own death in 1878. While magazines and publishers sought him out, soliciting his poetry for their publications, he wrote relatively little verse during his mature years. He did, however, carefully publish new editions of his collected poems every few years, adding his new work to the old. While he ceased to win much critical acclaim after the 1830's, he became a poet with a wide popular following. His poetry brought him additional wealth and the love of thousands of Americans.

The paper produced from this research, titled simply "William Cullen Bryant" will be published in the Dictionary of Literary Biography.



BERMAN, Neil, Assistant Professor, "Coover's Universal Baseball Association: Play as Personalized Myth," Modern Fiction Studies, 24 (Summer 1978), 209-222.

In recent American fiction there are a striking number of novels which use sports as their dominant theme. While the range of these novels varies widely in technique and in some assumptions, they all share the same startling vision of a world that is actively hostile to the essential elements of play: human joy, freedom, and creativity. Play, often specifically manifested as sport, offers the possibility, real or apparent, of achieving some liberation and hence self-definition, in a reductive world. Coover's novel stands as the supreme example of a completely internalized play-world which transcends the limitations of the mundane world. J. Henry Waugh (Yahweh) has created a game-world so completely internalized that it creates its own course and meaning, creates its own myths and rituals, entirely cut off from such established mythic traditions as are employed in Malamud's The Natural or Roth's The Great American Novel.

HILL, John M., Assistant Professor, "Beowulf, Value, and the Frame of Time," Modern Language Quarterly, 40 (March 1979), 3-16.

At least since J. R. R. Tolkien's 1936 essay on Beowulf, critics have usually assumed a double time scheme for the poem: the world of a doomed and flawed pagan past, no matter how heroic or appealing, and the world of providential time--the Christian present from which the past is judged. However, a close look at the poem's time schemes does not support such a view. Rather, the poet seems to work with ideas of continuity between the past and any present from which the poem is read or heard. Repeatedly he emphasizes continuity through time, not a dissociation of the present from the past, and a sharing of values, not a transcendence in Christian time of pagan inadequacies. His noble characters--Beowulf, Hrothgar, Wiglaf especially--express a theism quite similar to the poet's own (expressed in his narrator voice). Often the poet approvingly comments on scenes and moments of heroic life, gesture and the doing of what is good. Moreover, within a past tense framework, the poet moves from action to allusion and back again within a time scheme that begins in a distant past and, through anticipations of a future, encroaches unerringly on any present from which the poem is heard. What the poet has done is authenticate a value-laden and temporal connection between himself and the heroic past he depicts. That in effect makes Beowulf's world all the world there is for the poet's depiction of man's relationship to ethical values, to his lord and to God.

JASON, Philip K., Associate Professor, "The First Writers-in-Residence: MackKaye and Frost," Michigan Quarterly Review, 17 (Summer 1978), 377-391.

In the early 1920s, Percy MacKaye and Robert Frost became the first writers to accept patronage positions at American universities: MacKaye at Miami University of Ohio (1920) and Frost at the University of Michigan (1921). By 1920, the burgeoning university system had become a democratizing agent, and one way in which its democratizing impulse embraced the arts was through the concept of university patronage. MacKaye and Frost were men whose democratic and nationalistic outlooks made them fit choices for these early residency positions. Though neither man had stated duties, each involved himself in the academic community in ways which established the pattern for the writer-in-residence positions that proliferated after World War II. MacKaye, more reclusive than Frost, took his opportunity to research and develop plays and poems based on Appalachian traditions. He also found time to interact with faculty and students in mutually beneficial ways. Moreover, he was a forceful advocate of the patronage idea and helped Frost obtain the position at Michigan. Once there, Frost found himself meeting student groups on a regular basis, arranging for visiting speakers, and advising those who worked on the student literary magazine. Though Frost often complained about such distractions, there is evidence that he, like MacKaye, found the patronage arrangement congenial and conducive to literary productivity. (This article resulted from NARC funding.)

McFADDEN, Jeffrey E., Midshipman 1/C, "Chivalry and the Military Officer: An Historical and Literary Inquiry," Trident Scholar Project Paper Number 98, Nimitz Library, U. S. Naval Academy.

This study utilizes pertinent works of literature and biography in tracing the historical development of the concept of chivalry as it has been adopted and applied by the military officer. It begins with the fourteenth century, when the concept of the "gentleman officer" first appears. In two long chapters, it focuses on two major figures who stand as chivalric exemplars: Sir Gawain, in Arthurian literature, and Vice Admiral Horatio Lord Nelson, as leader in the Royal Navy of Great Britain. The final chapter of the study concentrates on aspects of chivalry that relate to naval officers and the naval service today. The study also includes a long glossary of chivalric terms.

NOLAN, Charles J., Jr., Assistant Professor, contributor, Annual Bibliography of English Language and Literature for 1975. Volume 50. Leeds, England: Modern Humanities Research Association, 1978.

Contributions to the Annual Bibliography of English Language and Literature by the researcher come from a careful review of the many issues of sixteen journals ranging from Anthropological Linguistics to the International Philosophical Quarterly. The contributor examines and notes any article, edition, book, or thesis, published in any language, that has an important link to English or American language or literature and any ancillary work that bears significantly on those fields. Using a specialized format, he then prepares bibliography cards for such items and forwards them to the American editor, who in turn sends the American contribution to Leeds, England, where the Annual Bibliography is published. The result each year is one of the two major bibliographies in English studies.

NOLAN, Charles J., Jr., Assistant Professor, "Cotton Mather: An Essay in Bibliography," Resources for American Literary Study, 8 (1978), 3-23.

Though Cotton Mather has long since been rescued from the Menckens, our conception of the man, his works, and his literary influence has undergone continual redefinition. Hence this article examines the major books and articles dealing with Mather that have been published since his lifetime. Included in the survey are bibliographies, editions, manuscripts, letters, biographies, and critical studies, the latter two categories occupying the major portion of the essay because of their obvious importance for assessing Mather's place in literary history. In general, scholars are split in their view of Mather the man. Some have seen him as narrow and pedantic; others, especially in the twentieth century, as misunderstood and brilliant. No doubt a sympathetic assessment will finally prevail. Mather criticism, of course, has suffered from a similar bifurcation, though appreciative studies have been and will continue to be most plentiful. Some of the major works, certainly the Magnalia, have received extensive analysis, and more, clearly, will come; of the 450 books comprising Mather's canon, only a few have been exhaustively treated. Hence much yet remains to be done, especially the tasks of editing various texts, of explicating minor works, and of providing a clearer focus still of Mather's influence on the nineteenth century.

ROSS, Stephen M., Assistant Professor, "'Voice' in Narrative Texts: The Example of As I Lay Dying," PMLA, 94 (March 1979), 300-311.

As I Lay Dying forces us to contemplate "voice" as central to our experience of narrative. Two kinds of voice can be distinguished in the novel, mimetic and textual. Mimetic voice derives from represented speech, from those features of the novel's discourse that prompt and enable readers to identify speakers. Faulkner's novel calls attention to this automatic process by dissimulating the origins of voices. Those we hear in dialogue turn out to belong to narrators; the voices of narrators seem to originate in an "absent" author's discourse. Textual voice arises from the expressive potential of the printed text. Faulkner exploits italics, drawings, lists, section headings and other features of the printed book in order to generate signification independent of verbal meaning or of represented speech acts.



PRESENTATIONS

ENGLISH DEPARTMENT

BOATMAN, John P., Associate Professor, "Burns' 'Liberty and Love--a Cantata' (The Jolly Beggars) and the Green World of Vagabond Tradition," Burns Literary Dinner, Burns Society of Annapolis, 24 April 1979.

BOATMAN, John P., Associate Professor, "Machiavelli, Marvell, and Auden: The Domestication of Political Violence," Westminster Seminar, Annapolis, 28 November 1978.

JASON, Philip K., Associate Professor, Reading and discussion of author's poetry, Writer's Center, Glen Echo, Maryland, April 1979.

NOLAN, Charles J., Jr., Assistant Professor, "The Darker Side of Romanticism: Aaron Burr, American Authors, and Society's Fears," Northeast Modern Language Association, Hartford, Connecticut, 30 March 1979.

NOLAN, Charles J., Jr., Assistant Professor, Chairman, Panel on "Literature and Composition--Dangers and Values," Conference on College Composition and Communication, Minneapolis, Minnesota, 6 April 1979.

ROSS, Stephen M., Assistant Professor, "The Structure of Desire in Modern American Family Fiction," Fifth Annual New York College Colloquium on Contemporary Methods of Critical Analysis, CUNY, New York City, 11 May 1979.

TINSLEY, Molly, Assistant Professor, "Muddle Etcetera: Syntax in A Passage to India," E. M. Forster Centenary Conference, Montreal, Canada, 3-5 May 1979.

TINSLEY, Molly, Assistant Professor, Reading and discussion of author's short story, "Exposure," Kensington Public Library, Kensington, Maryland, November 1978.

PRESENTATIONS

ENGLISH DEPARTMENT

TINSLEY, Molly, Assistant Professor, Reading and discussion of author's short story, "Raw Bacon," Writer's Center, Glen Echo, Maryland, 13 May 1979.



HISTORY DEPARTMENT

Professor Larry V. Thompson, Chairman



The History Department experienced another successful year of research and publication in 1978-1979. Two books were published: a biographical study of an important naval officer and a history of a New Deal planning agency. Department faculty members also contributed three chapters to important edited works and produced three articles for prestigious journals. Further scholarly products are anticipated, as faculty members presently have four manuscripts in-press, with publication expected early in the next academic year. Additionally, the proceedings of the 1977 Naval History Symposium have

been edited within the Department and book publication is scheduled for the fall of 1979.

The History Department continues to be active in participation at scholarly conferences held throughout the country. Staff members served as chairmen or commentators for five programs during the year and delivered seven presentations to various professional groups. Additional presentations were made to war colleges, naval reserve units, and university faculties.

Four recipients of Naval Academy Research Council grants pursued research projects as diverse as editing the Papers of John Paul Jones, preparing a monograph of Carolingian military strategy, examining the attitudes toward one another exhibited by turn-of-the-century scientists and humanists, and investigating the climate and causation surrounding ethnic riots involving naval personnel in Los Angeles during World War II. Furthermore, five Naval Academy Research Council grants have been awarded to the Department for the summer of 1979. These projects, when added to the sponsored and independent research efforts currently underway, ensure that abundant historical scholarship will be forthcoming in the near future.

In sum, the History Department remains heavily involved in research which is reflected in the enrichment of the classroom experience as well as in considerable numbers of scholarly publications and professional papers.

THE "TWO CULTURES": TOWARDS AN INSTITUTIONAL ANALYSIS OF THE PERIOD 1880-1930

Researcher: Assistant Professor P. Robert Artigiani

Sponsor: Naval Academy Research Council

Although certain individuals have argued philosophically for the fundamental unity of the creative process in the sciences and the humanities, this research indicates that C. P. Snow's distinction between the sciences and the humanities remains significant for historical reasons. Viewing each culture through the social science techniques pioneered by Weber and others suggests that the "paradigms" used to institutionalize the professional behavior of scientists and humanists in the later 19th century produced fundamental antagonisms which grossly affected the images each group had of the other. But careful analysis of scientific professionals in the 1900-1930 period further indicates that a paradigmatic shift occurred which reversed the view most major scientists had of the humanists. A comparable analysis of the humanist community has not been completed. At present, however, it appears that humanists have been extremely reluctant to appreciate both the degree and quality of the changes resulting from scientific developments since 1900. Consequently, despite the fact that the image scientists have of humanists has made the former more conciliatory toward the latter, there has not been a comparable change in the images humanists have of scientists. Thus the tradition of antagonism inherited from the 19th century seems still to be affecting the relations between the two cultures.

THE PAPERS OF JOHN PAUL JONES

Researcher: Assistant Professor James C. Bradford

Sponsor: Naval Academy Research Council and National Historical Publications and Records Commission

This project will produce a complete, scholarly edition of the writings of John Paul Jones. The first step (currently underway) is the collection of Jones' materials. To date copies of Jones' papers have been secured from over twenty repositories. Over a thousand items have been accessioned and filed, targets have been prepared for future photographing, and transcribing of documents has begun. Collection will continue next year. In the future, documents will be prepared for microform reproduction, a subject index will be prepared, and a finding-guide produced. Lastly, a one or two-volume, highly-selected letterpress edition will be prepared to supplement the planned 7 reels of microfilm.

DYNAMIC MILITARY ENGAGEMENTS THROUGH COMPUTER GRAPHICS

Researcher: Associate Professor William M. Darden

Sponsor: Naval Academy (Academic Dean)

The purpose of this project is to show in the classroom, graphically with the computer, the events leading up to selected battles, the developments during the battles, and the results. Along with the above, complete tables of statistics for all forces involved in the battles are made available. Pictures of the more important commanders, weapons, and areas of battle can also be shown.

On line now are land battles of the American Civil War, and those involving Frederick II of Prussia, and Napoleon. Naval Battles of World War II, the American Revolution, and the War of 1812 are also available. "Under construction" at this point are several United States Marine Corps amphibious operations of World War II.

THE NORSE IMPACT UPON MILITARY STRATEGY IN WEST FRANCIA, 862-869

Researcher: Assistant Professor Carroll M. Gillmor

Sponsor: Naval Academy Research Council

Until the Northmen first attacked the seacoasts and later directed their raids from inland waterways, the strategy of Carolingian monarchs (Charlemagne and his successors) had been directed towards problems of offensive wars of conquest on land. With the coming of the Norse invasions, control of the waterways emerged as the major strategic objective for the first time in the military history of western Europe. The purpose of this study is to demonstrate that Charles the Bald, a grandson of Charlemagne, devised an effective strategy to deal with these sea raiders, and, in so doing, brought about a shift from offensive to defensive warfare. By examining the response of a land-oriented military force to invasion by sea-raiders, this work will make a significant contribution to the early history of European seapower. Moreover, in addition to overturning some commonly held assumptions about the warfare of this period, analysis of these military events will help to explain the dismemberment of the Carolingian Empire, a development which was of the utmost importance for the territorial formation of modern European nations.

Through the application of textual analysis and the interdisciplinary methodology of archaeology and iconography, this study will explain the dynamics of change from an offensive to a defensive strategy. Moreover, the incorporation of comparative data on Norse cavalry operations in England as well as fortification-building both in England and Germany will

place the strategic shift in West Francia in the broader context of ninth century European military history.

As of this writing, three topics have been investigated: (1) the Norse acquisition of horsemanship skills, the extent of their mounted raids, and the question of their influence on the tactical composition of the Frankish army; (2) the construction of fortified bridges in the Seine basin, including the entire bridge-building process and its impact on the existing military organization; (3) the extension of this project into the Loire region owing to the ineffectiveness of offensive operations after the death of Robert the Strong at Brissarthe. This study has reached the stage of a rough draft consisting of three chapters. Work continues on a revision.

NAVAL SOCIAL RESPONSIBILITIES IN LOS ANGELES RIOTS of 1943: A NEW PERSPECTIVE

Researcher: Lieutenant Don Thomas Sine, USN

Sponsor: Naval Academy Research Council

In June 1943, a riot took place in the city of Los Angeles, California, between boys and men of Mexican-American heritage and sailors of the United States Navy. Although the riot took place only over a period of six days and nights, the seeds of discontent had been growing over two years, and the ramifications of the riots were felt not only in California, but also in Washington, D. C., Mexico, Germany, and Japan. Various investigations took place to determine if the riots were backed by the Communists, a Fifth Column element, or dissidents in this country, and if they were aimed at upsetting the war effort.

Research will be directed toward determining the validity of the accusation that foreign agents and/or domestic dissidents were the catalyst for the riots, what role racial prejudice played in the riots, and why the riots were "down-played" by local, state, and federal government agencies.

Present efforts are directed towards completing portions of a manuscript of eight chapters.

THE ESCORT BUILDING PROGRAM AND THE BATTLE OF THE ATLANTIC

Researcher: Midshipman 2/C Thomas Belke

Adviser: Assistant Professor Robert William Love, Jr.

This is an independent, non-credit project seeking to explain the relationship between the course of the Battle of the Atlantic in 1942 and early 1943 and the U.S. Navy's escort-shipbuilding programs. This is basic research which has not been undertaken to date and involves identifying each escort vessel of the DE or DD type built in 1942 or early 1943, tracing its deployment or transfer under Lend Lease, and calculating the influence of new construction on the order of battle of both the Atlantic Fleet and the Sea Frontiers. Work on this project will continue next year with the objective of producing a publishable article.

A HISTORY OF THE FIRST MARINE DIVISION 1941-1979

Researcher: Professor William M. Belote

The objective of this project is to present a balanced, illustrated, chronological account of the entire history to date of the First Marine Division of the United States Marine Corps. The book will consist of approximately 60,000 words, will be profusely illustrated, and will cover all campaigns in which the division has participated. The Historical Division of the Marine Corps is furnishing research materials and photographs to be selected by the editors. The book is intended to be the first volume of a series on famous American divisions.

THE ENCYCLOPEDIA OF U.S. NAVY AND MARINE CORPS HISTORY

Researchers: Associate Professor Kenneth J. Hagan and Assistant Professor Jack Sweetman

This work has been conceived to remedy the lack of a single, "one-stop" reference to which the student or researcher can turn for coverage of all important aspects of U.S. Navy and Marine Corps history. Alphabetically organized, it will consist of approximately 1500-2000 entries, combining the operational, administrative, biographical, and technological threads of American naval history. In terms of content, the entries will be of two types: brief, purely factual entries on specific subjects (individuals, battles, aircraft types, etc.) and longer, analytical entries on topical areas (amphibious operations, anti-submarine warfare, gunboat diplomacy, and so forth). The work should prove an invaluable aid to anyone involved in naval history, whether student, teacher, historian, or buff. The expected completion date is late-summer 1980.

ESSAYS ON NAVAL TOPICS

Researcher: Associate Professor Kenneth J. Hagan

This project consisted of a series of more than twenty essays on topics in American naval history, researched and written for two encyclopedias: Collier's and The Academic American Encyclopedia, both of which are scheduled for publication in 1981.

THE BRAIN, EVOLUTION AND THE PURPOSES OF EDUCATION

Researcher: Associate Professor David E. Johnson

Interdisciplinary learning-theory requires us to consider the biological and social evolutionary endowments of the human brain as they relate to the educational purpose of developing personal autonomy and responsibility. A cybernetic learning-theory, integrating Alexandr Luria's neurological model with Jean Piaget's psychological model, results in a single theory that shows the parallel structure of the two views. These theoretical structures are used to examine existing educational practices, i.e., grading credits, majors, etc., so critically assailed in many recent studies. These studies indicate the institutional constraints placed on the student which undermine those behaviors thought to be responsible for the evolved potential of the human brain. In particular it is argued that the development of those behaviors governed by the junctions of the frontal lobes are inhibited as a result of some present university teaching practices. The philosophical conclusion is that the educational goal of personal autonomy can be attained only if university teaching is based on the processes of learning and not conversely, as is commonly the case. If positive change is to occur, future action must be grounded in common social values supported by recent interdisciplinary knowledge. This study is a theoretical attempt to identify such values and knowledge in an integrated manner so as to advance the quality of higher education for all concerned.

RELIGION: ITS PHILOSOPHY AND LITERATURE

Researcher: Associate Professor David E. Johnson

A prospectus, annotated bibliography, and two specimen chapters of an anthology in the philosophy and literature of religion have been prepared for use as a college-level text. These materials are currently under review for possible publication. The eight projected chapters are: "God's Existence," "God's Power," "The Universe as Creation,"

"Man's Place in the Universe," "Man's Knowledge of God," "Man's Belief in God," "Good and Evil--the Ethical Problem," and "Death--and After." Introductions for the various sections of the book have been written by various academicians, including several at the Naval Academy.

THE CHIEFS OF NAVAL OPERATIONS

Researcher: Assistant Professor Robert William Love, Jr.

This is a collection of biographical essays on each of the first nineteen chiefs of naval operations, from Admiral William S. Benson to Admiral Elmo Zumwalt. Each author has attempted to explain why the admiral he is researching became CNO, what his major policies were in office, and how he succeeded or failed in implementing them. Since not all of the CNO's have been equally important, greater attention has been paid to those whose contributions have been most significant: Fleet Admiral King and Admirals Benson, Pratt, Stark, Sherman, and Burke. Each essay closes with an evaluation of the CNO from a historical perspective. In addition, the study includes an introductory essay on the origins of the office and the major changes in statutory and practical authority of the CNO's from 1915 to 1974.

FROM PEARL HARBOR TO TOKYO BAY: ERNEST J. KING AND THE AMERICAN NAVY IN THE SECOND WORLD WAR

Researcher: Assistant Professor Robert William Love, Jr.

This project is a major study of American naval policy and strategy under the leadership of Fleet Admiral King during the Second World War. Research on the first portion of the study which concerns the period from the Japanese attack on Pearl Harbor to the victory on Guadalcanal has been completed and the manuscript will be readied for publication. The major theme of this study is the significance of individual leadership in the formulation of national policies, as exemplified by the activities of Admiral King during the first year of the global war. Additionally, the study attempts to explain the close connections between theater strategies, arms transfers, institutional imperatives, military construction, and perceptions by leaders of national interests.

LOYALTY AND EXPERTISE: THE TRANSFORMATION OF THE NINETEENTH-CENTURY
GENERAL STAFF AND THE ORIGINS OF THE MODERN MILITARY ESTABLISHMENT IN
AMERICA

Researcher: Assistant Professor William R. Roberts

Discussions of American military history in the nineteenth century are usually more descriptive than analytical. To detect in the events of this century, as recent military historians have sometimes done, an overall trend toward professionalization and administrative centralization is, to be sure, a step in the right direction of developing a suitable framework of analysis for this period. Yet historians and social scientists have so far failed to explain the precise relationship of these two processes to each other and why they took place when they did.

This research focuses on one particular organization change--the creation of a modern American general staff in 1903. The general staff represented a major reform in civil military relations as well as in organization and administration and, as such, provides the historian with a unique opportunity to tie together a large number of disparate, antecedent events.

The research thus addresses two major, related questions: (1) why the American army adopted the general staff system, and (2) how that system contributed to the larger development of modern military organization. By tracing the demand for organizational reform in published and unpublished sources throughout the nineteenth century, it will be shown that the general staff was more than simply a response to a series of problems arising from the Spanish-American War, as previous historians have often asserted. As controversial as the latter war may have been, it was a precipitant rather than a cause of the organizational change in question. Moreover, by comparing the nineteenth-century Army with the Navy, those factors unique to the former can be isolated in order to clarify the causal relationships which contributed to the development of the general staff and the nascent centralization of command and administration evident in the Army after the turn of the century. Advocates of a general staff system were prominent in each branch of the service, yet in each instance the demands of men such as General William H. Carter and Admiral Henry C. Taylor elicited a noticeably different response. A comparative approach should lend itself not only to the clarification of causal relationships but also to a more meaningful treatment of subsequent organizational developments than has yet been achieved by those working wholly within the confines of military or naval history.

ORAL MEMOIRS OF ARTHUR J. SWEETMAN

Researcher: Assistant Professor Jack Sweetman

This project consists of developing and editing an oral memoir by Mr. Arthur J. Sweetman, covering the period 1894-1919. The work is envisioned as a piece of regional and military Americana, offering a first-person insight into the way of life and attitudes of an era almost lost to living memory. The experiences related include boyhood on the Eastern Shore of Maryland; service in the U.S. Navy, 1912-1914 (battle-ship New Hampshire; Dominican intervention, 1912; landing at Veracruz 1914); and service in the American Expeditionary Force in France, October 1917-March 1919 (St. Mihiel Offensive; Meuse-Argonne). The narrative structure is chronological.

THE GRAND ARMY OF THE REPUBLIC

Researcher: Assistant Professor Craig L. Symonds

The purpose of this project is to provide a brief analytical view of the Union Army in the American Civil War. Emphasis is placed on the catalytic impact of total war on American society and American institutions, and in particular on the institution of the Army itself. The paper resulting from this project will be included as a chapter in a forthcoming collection.

ESCAPE FROM CHAOS

Researcher: Associate Professor Rowan A. Williams

During World War I, Czech prisoners of war in Russia were organized into a "Czech Legion," which subsequently was trapped in Russia by the Soviet Peace of Brest-Litovsk. Initially the authorities agreed that the Czechs should be evacuated from Vladivostok to fight in France. Subsequently they impeded their departure. A wealth of published material has appeared in recent years, and the purpose of this project is to re-examine some unsolved questions in the light of this material. Some of these questions are:

To what extent did the Czechs seek independence from Austria?

To what extent did the Austrian and German prisoners of war in Siberia support the Red Army?

Why did the Soviet authorities first accede to the Czech evacuation and then seek to prevent it?

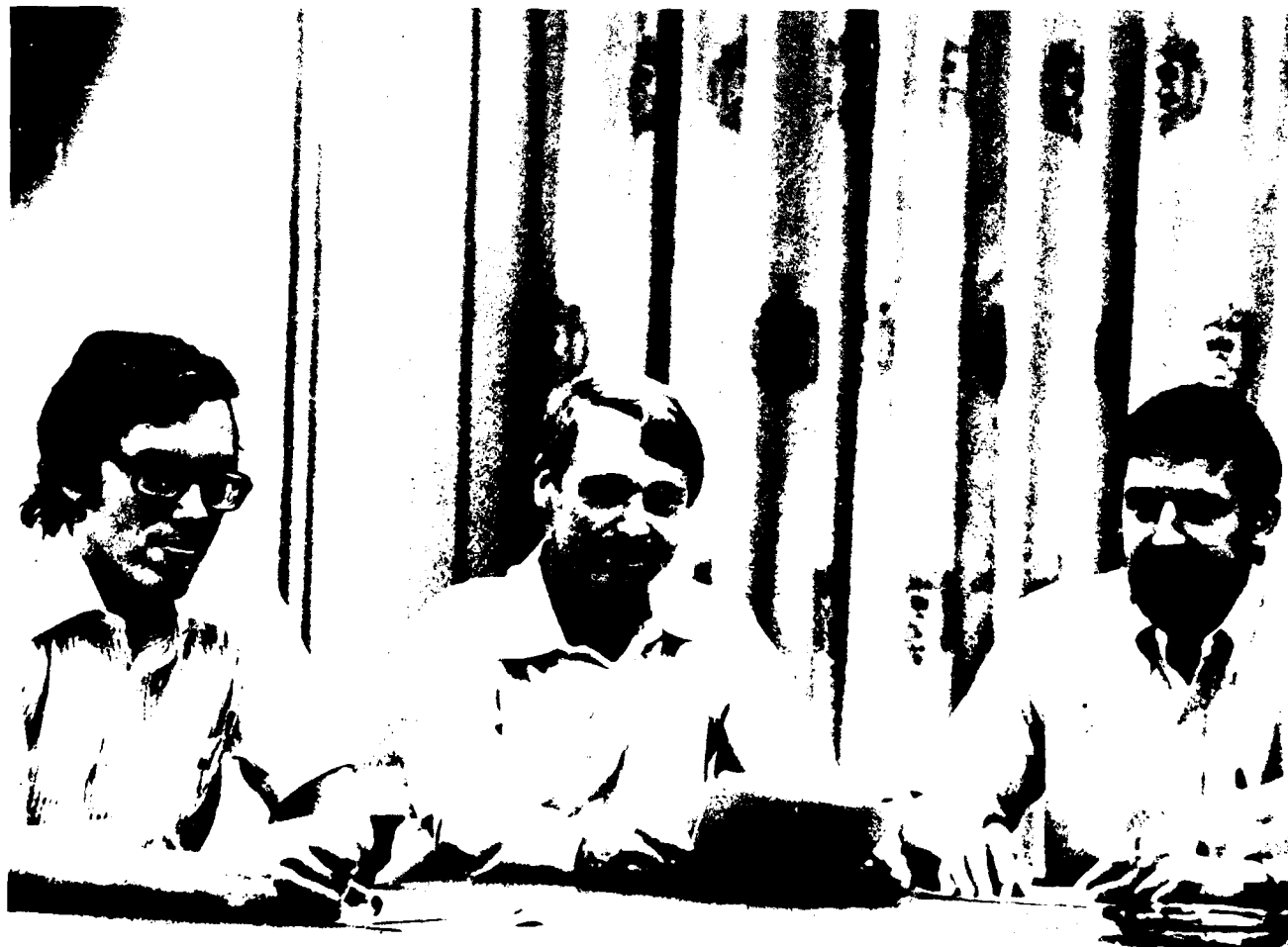
To what extent did the Czechs support the White forces of Admiral Kolchak?

REPORTING FROM PETROGRAD, 1916

Researcher: Associate Professor Rowan A. Williams

Lieutenant Sherman Miles, USA, was the U.S. Military attache in the Russian capital for ten months in 1916. His reports to the Army War College give unique insight into the Imperial Russian army at the opening of World War I, dealing with such subjects as the mobilization of the reserves; the troubles in munitions manufacture; the status of logistical support of the combat arms; the style of leadership in the officer corps; and the morale of the officers and enlisted men of the army.

The paper resulting from this project is principally a reduction of Miles' reports, which are preserved in the National Archives. The paper has been accepted for publication in 1980.



BARTLETT, Merrill L., Major, USMC, "Unwelcome Okusan," Marine Corps Gazette, 62 (August 1978), 39-45.

Most tours of duty for Marines in Japan are non-command sponsored (without families). With cheaper air fares, more and more Marines are bringing their dependents to Japan to subsist on the local economy. This influx of Americans is resisted in a covert fashion by the Marine Corps. Additionally, some families are unable to cope with foreign living. Positive factors include the opportunity for travel.

BRADFORD, James C., Assistant Professor, "The Navies of the American Revolution," in Kenneth J. Hagan, ed., In Peace and War: Interpretations of American Naval History, 1775-1978, Westport, Connecticut: Greenwood Press, 1978, pp. 3-26.

This chapter traces the development of the Continental Navy and its role in the American War for Independence. Emphasis is placed on the administration of the Navy, its contribution to the war effort, and its ultimate demise.

COLETTA, Paolo E., Professor, "The United States and Italy in the Allied Naval Council of World War I," in Atti del I Congresso di Storia Americana: Italia e Stati Uniti Dall'Indipendenza ad Oggi, 1776-1976, Genova: Tilgher, 1978, pp. 91-102.

As Commander of U.S. Naval Forces in European Waters, Admiral William S. Sims attended many meetings of the Allied Naval Council created late in 1917, said meetings being held in London, Paris, and Rome. He did what he could to stimulate the Italians to increase their ASW in the Mediterranean and Adriatic Seas. He found the Italians more willing to conserve their naval strength for postwar use, especially in the Adriatic, than to energize their ASW campaign.

COLETTA, Paolo E., Professor, Admiral Bradley A. Fiske and the American Navy, Lawrence, Kansas: Regents Press of Kansas, 1979.

Fiske (1854-1942), graduated from the Naval Academy in 1874 and went on to become the most gifted inventor in the naval service in his generation. Following his studying of electricity and writing a text-book on the subject, he sought particularly to improve ordnance and communications systems. Among the approximately sixty patents he acquired were those for the flashing light, helm angle indicator, electric engine order telegraph, electrified ash, coal, and ammunition hoists, electrified range finder, the stadimeter, and the torpedo plane.

After commanding single cruisers and monitors, he commanded cruiser divisions and battleship divisions and by 1912 was second in command of the North Atlantic fleet. After a year with the General Board, wherein he helped write war plans, he served for twenty-two months as Aide for Operations, equivalent to CNO. He was also responsible for the legislation that created the office of CNO. However, he failed to convince the Wilson administration of the need to prepare the Navy for war as long as he remained in office. In retirement after 1916, he wrote his memoirs, a book about inventions, two books about naval power, and also patented magnifying readers that permitted the reading of miniaturized printed matter, forerunner of microfiche.

LOVE, Robert W., Jr., Assistant Professor, "Fighting a Global War, 1942-1945," in Kenneth J. Hagan, ed., In Peace and War: Interpretations of American Naval History, 1775-1978, Westport, Connecticut: Greenwood Press, 1978, pp. 263-289.

This chapter explained and analyzed the major elements of American naval policy and strategy during the Second World War. Centering on Fleet Admiral Ernest J. King, the Chief of Naval Operations and Commander in Chief of the U.S. Fleet, the article dealt with four major themes which help to explain the evolution of these policies. The first was the interaction between the major Allies, the United States and Great Britain, and their differing views on grand strategy and theater strategy. The second was the personality and character of Admiral King, who dominated American naval policy and who played a key role in Allied debates over strategy. The third concerned the relationship between military production-- such as shipbuilding --and naval strategy. In this section, the central argument was that strategic decisions are essentially decisions about certain opportunity costs. The fourth theme involved the relationship of wartime foreign policies, or war aims, to military and naval strategies. Lastly, the chapter attempted to evaluate the success or failure of American naval strategy in the war.

SWEETMAN, Jack, Assistant Professor, "Notable Naval Books of 1978," U.S. Naval Institute Proceedings, 105 (January 1979), 95-99.

A total of nineteen titles were selected for this annual survey of the most outstanding books on naval and maritime subjects published in 1978 or too late in 1977 for inclusion in last year's survey. Topics of the works that were treated range from history to biography to current affairs. Foreign publications were included.

SYMONDS, Craig L., "The Antinavalists, Opponents of Naval Expansion in the Early National Period," American Neptune, 39 (January 1979), 22-28.

This is a brief examination of the motivations of the opponents of naval expansion in the period 1800-1820. Saving money was only one, and not the most important, of the reasons for opposing naval expansion. The real concern of the antinavalists was the mission of the Navy.

WARKEN, Philip W., Professor, A History of the National Resources Planning Board: 1933-1943, Ed. Frank Freidel, The Modern American History Series, New York: Garland Publishing, 1979.

This work concerns the most systematic effort of the New Deal to introduce some degree of centralized control to the management of the nation's economy. The agency charged with this difficult task was the National Resources Planning Board and its predecessor agencies. Beginning with efforts to assemble Federal construction projects into planned reserves to use as counter-cyclical tools to stabilize the economy, the agency quickly became concerned with the use of natural resources.

The most dramatic expansion of activity, however, coincided with the outbreak of the Second World War. Along with most of the rest of the government, defense and war-related undertakings took an increasing amount of agency time. The NRPB made studies of energy supply, worked to solve the problems of industrial congestion, and organized the committee to inventory the scientific and specialized personnel of the country.

The NRPB, however, continued to show its commitment to long-range planning by assuming responsibility for the coordination of post war plans. Even more importantly, the NRPB showed its continuing concern for improving the human condition by conducting studies on welfare programs, social security, health, education, and economic stability. Those results were largely consolidated into two reports which became the most controversial issued by the agency.

The post war reports were the last significant productions of ten years of work. Shortly after the reports appeared, Congress cut off funds for the NRPB and, after completing its housekeeping chores, it went out of existence on 1 August 1943.

PRESENTATIONS

HISTORY DEPARTMENT

ARTIGIANI, P. Robert, Assistant Professor, "The Moral Stance of the Engineer," United States Naval Academy, Annapolis, Maryland, 13 April 1979.

BRADFORD, James C., Assistant Professor, "John Paul Jones: New Perspectives and Opportunities for Research," North American Society for Oceanic History, Newport News, Virginia, 28 April 1979.

COLETTA, Paolo E., Professor, "The U. S. Navy in the Adriatic in World War I," First International Congress on World War I, Rovereto, Italy, 27 June 1978.

DARDEN, William M., Associate Professor, "Dynamic Military Engagements Through Computer Graphics," Association for the Development of Computer-Based Instructional Systems, San Diego, California, 28 February 1979.

GILLMOR, Carroll M., Assistant Professor, "The Development of Cavalry in the Historiography of Carolingian Warfare," University of British Columbia, Vancouver, B. C., Canada, 17 November 1978.

HAGAN, Kenneth J., Associate Professor, "The Impact of the Virginus Crisis on American Foreign and Naval History," Organization of American Historians, New Orleans, Louisiana, 12 April 1979.

LOVE, Robert W., Jr., Assistant Professor, "The Politics of American Naval Leadership," U. S. Marine Corps Command and Staff College, Quantico, Virginia, 20 September 1978.

LOVE, Robert W., Jr., Assistant Professor, "Radio Intelligence and Grand Strategy in the Battle of the Atlantic," Utah State University, Logan, Utah, 25 January 1979.

PRESENTATIONS

HISTORY DEPARTMENT

SINE, Don T., Lieutenant, USN, "Urban Turmoil: Causes and Effects of the Zoot Suit Riots in Los Angeles, 1943," Naval Reserve Unit VTU 0603, Annapolis, Maryland, 15 May 1979.

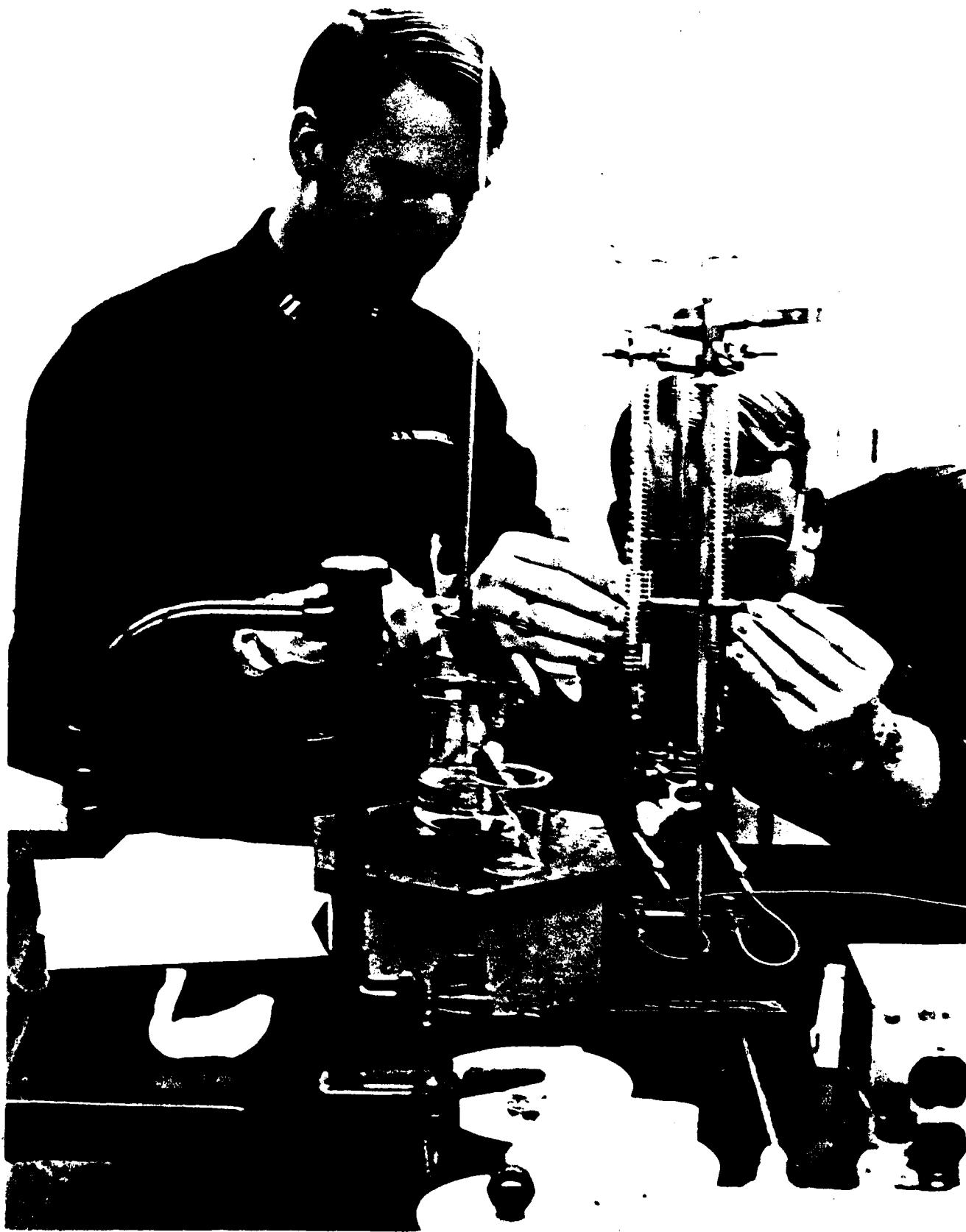
SWEETMAN, Jack, Assistant Professor, "The Confederate States Naval Academy," Baltimore Round Table of American Military History, Baltimore, Maryland, 17 May 1979.

THOMPSON, Larry V., Professor, "Metternich and Bismarck: A Comparison," Naval War College, Washington, D. C., 30 November 1978.

THOMPSON, Larry V., Professor, "International Politics, 1919-1939: The Fascist Insertion," Naval War College, Newport, Rhode Island, 21 May 1979.

WILLIAMS, Rowan A., Associate Professor, "Czechoslovakian Prisoners of War in Russia in World War I," American Association for the Advancement of Slavic Studies, Columbus, Ohio, 13 October 1978.





DIVISION OF
MATHEMATICS AND SCIENCE



APPLIED SCIENCE DEPARTMENT

Commander Neil L. Kozłowski, USN, Chairman



The Applied Science Department, consisting of three primary academic disciplines--Computer Science, Operations Analysis, and Resources Management--has continued to place special emphasis on midshipmen participation in research activities. As a result of the activities indicated in the following pages, students gain highly valuable insights into real-world applications of their recently acquired academic background. In addition, and to a very significant degree, a wide variety of naval organizations have benefited directly from these research endeavors.

Most of the research was within the Operations Analysis Study Group, and was supported by an annual grant from the Chief of Naval Operations (OP-953). Utilizing these funds, faculty members, working closely with a wide spectrum of agencies within the Navy, develop projects of current interest, and provide guidance to midshipmen in their academic pursuits.

Within the Resources Management discipline, a limited number of students are allowed to select and undertake research projects toward which realistic management problem-solving techniques can be applied. Through this process, the midshipmen gain valuable practical experience in the utilization of a variety of principles of management and organization which have been studied in their courses.

SPONSORED RESEARCH

APPLIED SCIENCE DEPARTMENT

MINESWEEPING TECHNIQUES: A DTSS PROGRAM TO EXPEDITE THE COMPLETION OF THE MECHANICAL-SWEEP WORKSHEET

Researchers: Midshipmen I/C Keith E. Anderson and Michael J. Szostak

Adviser: Lieutenant Commander Robert L. Peck, USN

Sponsor: Naval Coastal Systems Center

The current procedure for planning a minesweeping operation involves the completion of a long and detailed worksheet for every type of mine that could possibly be encountered by today's minesweeping platforms. The purpose of the worksheet is to compute the number of sweeps needed to give a desired level of clearance. Volumes I and II of NWIP-27 are presently being utilized to aid the operator in the completion of these worksheets. With the advent of minesweepers being equipped with computers, it is desired that a program be written to perform the function of NWIP-27 and to complete the worksheet for mechanical sweep with (1) greater speed, (2) higher accuracy, and (3) minimum input.

THE PROBABILITY OF MULTIPLE INTERCEPTS FOR ESM

Researchers: Midshipmen I/C Joseph J. Bradfield and James T. Strader

Adviser: Associate Professor Thomas D. Burnett

Sponsor: Center for Naval Analyses

One of the most important aspects of modern naval warfare is the field of electronic support measures. This paper derives an independent and dependent event-model of the multiple intercept case for an azimuthal scanning receiver, with special emphasis on the nature of the dependence, and the suitability of each model to describe the process.

HIGHER-ORDER BOUNDARY LAYER SOLUTIONS

Researcher: Assistant Professor Frank L. K. Chi

Sponsor: Naval Academy Research Council

Usually higher-order boundary layer solutions are obtained as approximate solutions of Navier-Stokes equations, which in turn are themselves approximate solutions of Boltzmann equation. We derived the Prandtl's boundary layer equations and higher-order boundary layer equations directly from the BGK

model of Boltzmann equation. The higher-order boundary layer equations so derived, are solved for incompressible fluid flow past a flat plate. It is found that this approach predicts a larger skin friction coefficient.

ANALYSIS OF CAPTIVE-CARRY RELIABILITY TESTS

Researchers: Midshipmen 1/C Mike A. Dean and Ray A. Pietrzak

Adviser: Commander Phillip S. Marsden, USN

Sponsor: Chief of Naval Operations (OP-095)

The Navy and the Air Force conducted a joint operational test on their respective versions of an air-to-air missile. Part of the test program consisted of a "captive-carry" non-firing reliability test in which a number of missiles were carried on board aircraft and periodically tested. Missiles suffering reliability-failures were repaired, modified, and continued in the test program. This report analyses the reliability data from this test and compares the reliability of the two service versions and the original and modified missiles.

EVALUATION OF A SIGNAL-EXCESS PREDICTION MODEL

Researchers: Midshipmen 1/C James O. Gay and George F. Kiefer

Adviser: Associate Professor Thomas D. Burnett

Sponsor: Chief of Naval Operations (OP-095)

A signal-excess prediction model was used to predict as a function of time, the level of signal-excess which is received by the detection platform. With the use of data obtained from actual fleet exercises, the validity of the model was investigated. This investigation was performed through the development of a model that predicts detection (probability) levels based on signal excess. In addition, methodology was developed to examine the validity of environmental and equipment calibration inputs to the signal-excess model when multiple ship/submarine encounters occur simultaneously.

SPONSORED RESEARCH

APPLIED SCIENCE DEPARTMENT

AN ANALYSIS OF SCORING SYSTEMS FOR MINELAYING EXERCISES

Researchers: Midshipmen 1/C David C. Marble and John G. Messerschmidt

Adviser: Lieutenant Commander Robert L. Peck, USN

Sponsor: Chief of Naval Operations (OP-095)

Presently, aircraft minelaying exercises are scored using a bullseye-type system in which each mine in the field is given a score according to the distance the mine is from its intended position. These scores are averaged and yield a score for the minefield. The resulting score, and the process by which it is established, may not be an accurate reflection of the effectiveness of the minefield. The goal of this project is to verify the validity of the current scoring technique, and to propose and evaluate alternate scoring systems for minelaying exercises.

SUBMARINE POSITIONING USING BOTH LINES-OF-BEARING AND SONOBUOY CONTACT DATA

Researchers: Midshipmen 1/C Kirk A. Michaelson and Samuel D. Pratton

Adviser: Associate Professor Thomas D. Burnett

Sponsor: Chief of Naval Operations (OP-095)

This project develops a probability map for submarine location that combines the data from both the sonobuoy detection and the multiple line-of-bearing fix. In order to accomplish this, the probability map of submarine location via the sonobuoy and the probability map of submarine location via the line-of-bearing fix must be determined. Since these two distributions are independent of one another, they can be multiplied together creating a new distribution of submarine location, thus forming the combined probability map.

SPONSORED RESEARCH

APPLIED SCIENCE DEPARTMENT

DEVELOPMENT OF AN ON-LINE BLOOD PRESSURE MEASURING CAPABILITY

Researcher: Associate Professor Karel Montor

Sponsor: Naval Academy Alumni Association (Gift Fund)

The Academy's Brain Wave Laboratory includes the capability to simultaneously measure brain waves, skin resistance, temperature, muscle voltage, and pulse. During the past year an on-line blood pressure capability was integrated into the operating system. This, along with a video presentation that is automatically controlled, makes it possible to measure reaction to stress as the subject/player competes with either an experimenter or with the wired logic of the TV program.

PROPOSAL TO PROVIDE SMALL CRAFT OPERATIONS WITH INDOOR ALL-WEATHER MAINTENANCE CAPABILITY

Researcher: Associate Professor Karel Montor

Sponsor: Naval Academy (Deputy for Management)

The Naval Academy uses both engine and sail-powered craft in programs designed and administered to meet the mission and objectives of the four-year program. The operating schedule of many of these vessels is year round, which makes overhaul and maintenance extremely difficult during the winter months. The proposal was designed to provide the Comptroller of the Navy and the Commander, Naval Facilities Engineering Command with knowledge about the Academy's sail and engine-powered professional development programs, the logistic and fiduciary related aspects, and the rationale of both why the Academy is manned to repair and maintain these craft as well as why providing an indoor winter-work facility is in the best interests of the Navy.

GRADUATE PERFORMANCE EVALUATION SYSTEM (GRAPES)

Researcher: Lieutenant Commander Kevin T. Moore, USN

Sponsor: Naval Academy (Division of Professional Development)

Serving as a form of USNA self-accountability, GRAPES captures the (1966, 1971, and 1975) graduate's appraisal of his preparation for effective and competitive service as a junior officer. Analysis of the individual questionnaire responses provides identification of specific strengths and weaknesses of the USNA program, for these responses are based upon seven years of personal experiences by these young men as midshipmen and as junior officers.

It is the long-term goal of GRAPES eventually to join such graduate feedback with an objective measure of graduate success in the military profession. Such a measure would represent an annual macroscopic appraisal of the total USNA program (including the admissions sub-program) for year-to-year comparison among USNA graduating classes and for comparison between USNA and competitive commission sources.

ESTIMATION OF MAXIMUM DETECTION RANGE OF AN AN/SSQ-62 SONOBUOY WITH THE HP-67

Researchers: Midshipmen 1/C John L. Rogers and James L. Reuss

Adviser: Lieutenant Commander Gilbert M. Marlowe, USN

Sponsor: Chief of Naval Operations (OP-095)

Because of changing sea conditions or the unavailability of ASRAPs, it becomes necessary to predict active ranges while on station. The purpose of a range estimation is to provide a statistical basis for determining the spacings between sonobuoys in an active sonobuoy search pattern. This report develops a model and program on the HP-67 handheld calculator that will estimate the maximum detection ranges of the AN/SSQ-62 sonobuoy.

NAVAL TACTICAL SHIP-TO-SHIP COMMUNICATION ENHANCEMENT USING MICROCOMPUTER PROCESSING

Researcher: Lieutenant Commander Jay A. Sears, USN

Sponsor: Naval Academy Research Council

Ship-to-ship tactical communications now utilize UHF transmitters and receivers to send tactical messages by voice which are then hand recorded by watchstanders on the bridge and in the combat information center (CIC). At times, messages may be missed and not recorded, or they may be incorrectly recorded, thus adding to the confusion for the watch team. It would be desirable to have an automatic data processing system that would assist in receiving, sending and recording messages. Space constraints on the bridge of most ships would require that this system be compact and lightweight. A microcomputer-based system would provide for these facilities as well as provide a means for encoding and decoding messages for security reasons.

The objective of this report is to develop software that handles the preparation, editing, transmission, and receipt of standard naval tactical messages and which could be resident in erasable-program memory of a microcomputer for controlling and processing messages.

A SENSITIVITY ANALYSIS OF AN HP-67 DIFAR SONOBUOY ALGORITHM FOR DETERMINING PARAMETERS OF ENEMY SUBMARINE LOCATION

Researchers: Midshipmen 1/C Don L. Shaw and Burke P. Shade

Adviser: Associate Professor Thomas D. Burnett

Sponsor: Chief of Naval Operations (OP-095)

In the process of localizing an enemy submarine using present AIR ASW tactics involving single DIFAR sonobuoys, submarine bearings as reported by the sonobuoy are assumed to be accurate in the HP-67 program algorithm. Yet acoustic conditions render this impossible, and in actuality they are random variables. Estimated submarine heading and time of CPA are then subject to error. Models are developed to simulate the submarine and sonobuoy scenario. Using the models, the sensitivity of the present algorithm to bearing-input errors is determined using perturbed bearings. Also, the models are used to determine if four bearings used three at a time will give increased accuracy over presently obtainable results.

OPTIMAL LOADOUT FOR A MULTIPURPOSE MISSILE MAGAZINE

Researchers: Midshipmen 1/C Gary A. Stahl and Kevin J. Becker

Adviser: Commander Phillip S. Marsden, USN

Sponsor: Chief of Naval Operations (OP-095)

The DDG-47 will be a multimission destroyer equipped with multi-purpose missile launchers. These launchers may fire ASROC, HARPOON, or Standard-1/2 missiles. The number of missiles carried will be limited by magazine capacity. The purpose of this report was to determine the optimal mix of weapons to load in the ship's magazines prior to a hypothetical operational scenario. A dynamic programming model was used to solve this allocation problem.

MINESWEEPER SAFETY AS A FUNCTION OF INDUCED MAGNETIC FIELD STRENGTH

Researchers: Midshipmen 1/C Keith D. Tindall and Micki L. Fernbaugh

Adviser: Associate Professor Thomas D. Burnett

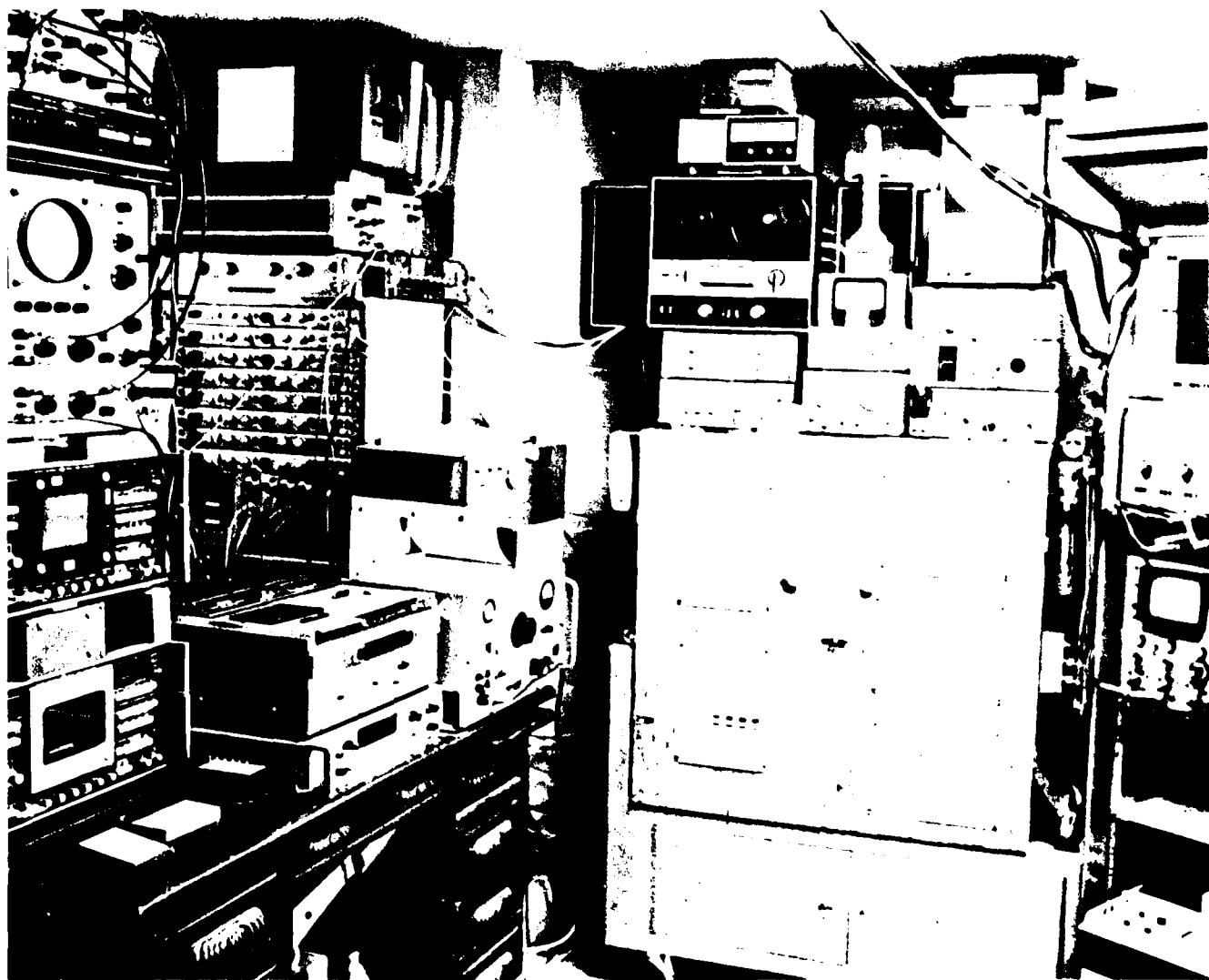
Sponsor: Chief of Naval Operations (OP-095)

Minesweeper safety is dependent upon several key variables: actuation width, actuation probability, damage probability, and dangerous front. The value of these variables is dependent upon the induced magnetic-field strength. Combining probability theory with present mine countermeasure-procedures as a foundation, a computer simulation model is developed. This model simulates a minefield with given mine density, magnetic mine type, type of minesweeper, and type of sweep configuration. Comparisons of minesweeper safety are made as the induced magnetic field strength is varied. The final result is in the form of an algorithm by which a minefield sweeping planner may select an induced magnetic field strength that will minimize total risk to the minesweeper. Total risk takes into account the number of runs per track required for a certain degree of clearance and the risk for each run. This algorithm is primarily of value when there is a time constraint placed in the scenario.

ANALYSIS OF PHYSIOLOGICAL DATA

Researcher: Associate Professor Karel Montor

Data continues to be taken and analyzed for the Class of 1980. A study comparing performance of smokers to non-smokers indicates that the latter group has significantly better academic (.001) performance than those who smoke. Military performance differences and conduct favored the non-smokers at the .05 significance levels. Analysis of data related to Vitamin C intake supports the concept that better grades are achieved by those whose retained Vitamin C levels are higher than the norm.



SEARCH TACTICS: THE BAYESIAN WAY

Researcher: Midshipman 1/C Gregory T. Hutto

Adviser: Lieutenant Commander Gilbert M. Marlowe, USN

The author develops a general-search scenario with a bivariate normal-target-location distribution and a target not moving relative to the search platform. Utilizing a general Lateral Range Curve appropriate to a continuous-looking search device, a computer program generates Bayesian A Posteriori probability distributions following each leg of the track. A Bayesian tactic is developed and compared with a ladder search and an expanding square through the same area. The Bayesian tactic is found to be superior to the expanding square for short on-station times, with probability of detection versus cumulative search time being the measure of effectiveness.

A COMPARISON OF THE CLASS OF 1978 USNA GRADUATE PERFORMANCE VERSUS OTHER SOURCE PERFORMANCE AT THE BASIC SCHOOL AND SURFACE WARFARE OFFICER SCHOOL

Researchers: Midshipmen 1/C Peter F. Long and Roger R. Royston

Adviser: Lieutenant Commander Kevin T. Moore, USN

Each year the Naval Academy provides the Naval service with approximately 900 commissioned officers who select a specific warfare specialty to enter upon graduation. In conjunction with the Naval Academy Graduate Performance Evaluation System (GRAPES), this study analyzes the performance of the Naval Academy Class of 1978 at The Basic School in Quantico, Virginia, and at Surface Warfare Officer School in Newport, Rhode Island, and compares their performance with the performance of their contemporaries from other accession sources.

RESEARCH COURSE PROJECTS

APPLIED SCIENCE DEPARTMENT

ANALYSIS OF SICK CALL RECORDS FOR THE CLASS OF 1980

Researcher: Midshipman 1/C Robert J. Rubin

Adviser: Associate Professor Karel Montor

An extensive data-collection effort was started during the summer of 1978 to establish the relationship of illness and injury incidence to other known factors. Illness statistics were developed ranging from appendicitis to skin rash. Injury statistics were assembled ranging from surgery required to Band-Aid application.

An analysis of this data will be done against four-year records, with a view to establishing causal and correlational relationships.

A PROPOSED RESOURCE-RECOVERY FACILITY FOR THE U. S. NAVAL ACADEMY

Researcher: Midshipman 1/C Scott R. Van Buskirk

Adviser: Major Don Swaby, USMC

The use of readily obtainable energy from a waste-heat recovery facility at the Naval Academy could result in a substantial savings in energy and operational costs approaching \$100,000 a year after initial payback has been accomplished.

Systems presently exist which can burn the refuse generated at the Academy while providing valuable energy in preheating hot water returning to the Central Heating Plant. This facility would serve a dual purpose by (1) reducing the Naval Academy fossil fuel requirements, and (2) reducing operational and maintenance costs associated with conducting disposal services.

CHI, Frank L. K., Assistant Professor, co-author, "Direct Energy Conversion Devices and Their Potential Naval Applications," Naval Engineering Journal, 91 (February 1979), pp. 87-96.

Direct-energy-conversion devices may be used as prime movers, refrigerating machines, etc. and are endowed with characteristics well-suited to diverse naval applications. Despite this, not much effort has been invested in the U. S. Navy in their development. There is a real and urgent need for substantial fundamental work in this area to be initiated. Developments of thermoelectric converters, thermionic generators, photovoltaic cells, magnetohydrodynamic (MHD) systems, and fuel cells are surveyed. A comparison between conventional energy conversions and direct energy conversion in size, weight, and efficiency is made. Potential application of these direct-energy-conversion devices for naval use is studied.

MONTOR, Karel, Associate Professor, "Instrumentation for Brainwave Signal Processing," Proceedings of the Seventh New England (North-east) Bioengineering Conference, Troy, New York: Rensselaer Polytechnic Press, 1979, pp. 321-323.

This paper deals with real-time analysis of brain waves which can be accomplished by using signal-analysis techniques developed for detection of underwater surfaces. Results of analyzing 1227 records of the Class of 1980 are reported along with photographic representations of various techniques of signal analysis.

PRESENTATIONS

APPLIED SCIENCE DEPARTMENT

CHI, Frank L. K., Assistant Professor, co-author, "Higher-order Boundary Layer Solutions," Annual Spring Meeting of American Physical Society, Washington, D. C., 23-26 April 1979.

MONTOR, Karel, Associate Professor, "Instrumentation for Brainwave Signal Processing," Seventh New England (Northeast) Bioengineering Conference, Troy, New York, March 1979.





CHEMISTRY DEPARTMENT

Professor Samuel P. Massie, Chairman



Research plays a significant role in the life of the Navy as well as providing support for the academic life of an institution of higher learning.

Toward the goal of preparing young persons to be naval officers, the inclusion of some research activity in the senior year offers the opportunity to polish some of their specific chemical skills; but, more important, it gives them some experience as bench scientists. In mid-career many of these officers will find themselves managing R&D and may draw on their own experience

to help understand the process.

For the faculty, the goal is similar but distinct. Participation in purely scientific activity serves to maintain the professional competence of the professor and to aid in his remaining current in his field. A further benefit is obtained when Navy problems are undertaken as sponsored projects. The examples that are made available for classroom use and the changes in emphasis that such experience offers are enriching in the support of naval education.

Toward these ends the following pages offer a sample of the activity undertaken by the Chemistry Department.

METAL PARTICIPATION IN METALLOCENE CHEMISTRY

Researcher: Lieutenant Thomas E. Bitterwolf, USN

Sponsor: Naval Academy Research Council

Previous research on metallocenes has centered primarily on the synthesis of new and increasingly complex molecules containing the metallocenyl moieties. Little interest has been directed toward the possible role of the metal in the behavior of these compounds and in the mechanisms of their reactions. This research is directed toward the behavior of several reaction intermediates which have or may have significant metal involvement. Specific topics include the conformational behavior of protonated ferrocenes in strong acid, conformational behavior of ferrocenyl carbenium ions, possible internal proton transfer in the hydroxy ferrocene molecule, and isolation and reactions of the protonated ferrocene itself. Ultimately this work will be expanded to include other iron-group metallocenes and metallocenes of the Group VI and VII metals.

Intensive effort on synthesis of bridged ferrocenes has led to preparation of nearly all of the compounds needed for the mechanistic study. Only the compound with a two-carbon bridge has eluded preparation. Preliminary examination of the experimental conditions required to permit study of the reactive intermediates in strong acid has defined the critical parameters and permitted their control in the main study.

COMPUTER-AUGMENTED VIDEO EDUCATION IN CHEMISTRY: LABORATORY EXERCISES

Researcher: Associate Professor Frank J. Gomba

Sponsor: Naval Academy (Academic Dean)

This is an ongoing program to develop and explore the utility of computer-augmented video education (CAVE) that utilizes both computer and ETV programs. The project has a three-fold purpose: (1) to provide pre-laboratory instruction, emphasizing correct laboratory procedure and data collection; (2) to provide drill on data treatment, both visually via ETV and by computer presentation; and (3) to provide realistic, but randomly created, data that could have been collected by laboratory measurement. Emphasis in this phase was on Acid-Base Titration Curves involving the proper utilization of the laboratory apparatus, data collection, and data reduction and interpretation. Evaluation of this phase has not been completed as of this writing.

Work is underway to edit all of the programs prepared thus far in order to make them compatible with an automatic, computer-controlled system developed by Professor Ralph Santoro of the Electrical Engineering Department.

COMPUTER AUGMENTED VIDEO EDUCATION IN TROUBLESOME AREAS OF CHEMISTRY

Researcher: Assistant Professor John V. Prestia

Sponsor: Naval Academy (Academic Dean)

An on-going study of the use of television and computer to present interactive tutorial material for problem solving in general chemistry was undertaken by producing pilot programs from typically troublesome concepts such as molecular weight, ideal gases, and hydrolysis of salts.

During this reporting period, one complete package (SC9519) covering the general equilibrium problems was prepared. This program permits the student to work on different parts of the problem (his choice) or the complete problem, and provides help-sequences to steer the student through the problem in a step-by-step pattern.

NEW POLYMER DEVELOPMENT AND CHARACTERIZATION

Researcher: Associate Professor Robert R. Ressler

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

This study embraced three goals:

1. To experiment with modifying the formulation of an antifouling epoxy-coating preparation by altering the proportion, or even the nature, of the accelerator in order to achieve a more rapid, room temperature primary curing and hardening in order to minimize the dead-time between painting and use.
2. To assist in establishing a program of experiments to be carried out by a full-time chemist at NSRDC investigating the possibility of improving antifouling capability and physical properties of certain epoxy coatings by using polyblending techniques.
3. To survey the literature looking for what has been accomplished in the way of blending polyvinylidene fluoride in other polymers as matrices seeking for possible extension of tested procedures to developing piezoelectric, antifouling products.

Successful formulations were prepared with requisite hardness and cure-times. The experimental program to investigate applications of polyblending was successfully completed as well as the literature survey.

HYDROGEN BONDING STUDIES

Researcher: Associate Professor Charles F. Rowell

Sponsor: Naval Surface Weapons Center, White Oak Laboratory

Many of the medium energy forces that bind molecules together are traceable to hydrogen bonding. These same forces are responsible for "wetting" and adhesion between glues and substrates and between polymer binders and fuels in solid-propellant rocket motors.

Work by M. Kamlet and co-workers at the Naval Surface Weapons Center, White Oak Laboratory, using the shift in ultraviolet absorption maxima when test dyes were placed in various solvents, has been successful in quantitatively relating relative hydrogen bond-strengths. Unfortunately, the test dyes absorb in the same range as the nitramine chromophore of propellant fuels and the monomer of the binder.

During the summer, four new dyes, whose absorption maxima avoided these ranges, were synthesized and their properties measured successfully. During the ensuing months a computer program to give the best fit for the four parameter equation has been written and validated.

EFFECTS OF IONIZING RADIATION ON THE RELEASE OF LYSOSOMAL HYDROLASES FROM MOUSE PERITONEAL MACROPHAGES

Researcher: Lieutenant Commander Stephen L. Snyder, USNR

Sponsor: Defense Nuclear Agency

The release of lytic enzymes from subcellular organelles called "lysosomes" is accelerated following whole-body exposure of animals to ionizing radiation. This phenomenon may be of fundamental importance in understanding how radiation causes tissues injury and death. Three mechanisms of injury evoked by radiation-induced changes in distribution of lysosomal enzymes are envisioned. Released hydrolases can attack cytoplasmic and nuclear constituents of cells, thereby disrupting cell-function, ultimately resulting in cell-death (intracellular attack). Alternatively, enzymes may escape from injured cells and attack previously uninjured neighboring cells, thereby amplifying the initial

trauma (intercellular attack). A third mechanism involves the action of lysosomal proteases (cathepsins) on serum or tissue proteins to produce potent inflammatory mediators (kinins). In addition to their potential importance as inflammatory agents contributing to acute radiation syndrome, lysosomal hydrolases may have value as biologic markers for quantitating radiation-induced injury. We have recently shown a dose-response relation in the ratio free/bound β -glucuronidase and α -fucosidase in spleen homogenates prepared from irradiated rats.

The short-term objective of this investigation is to explore the use of lysosomal enzyme secretion from macrophages as a biologic indicator of radiation injury. Since macrophages are an important component of the host's immunologic defenses, the relationship between lysosomal enzyme release and cell-function will also be investigated. In addition, as a long-term goal, it is hoped that these studies will lead to a better understanding of the mechanism of radiation-induced enzyme release at the cellular level.

THE SOLUBILITY OF WATER IN FUEL LIQUIDS DERIVED FROM COAL, OIL-SHALE, AND TAR SANDS

Researcher: Professor John G. Zimmerman

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

Determination of the potentially harmful component of water in synfuels and syncrudes is important because the solubility of water is a function of fuel composition which may be appreciably different from that of petroleum-based fuels.

The analytical method employed a Karl Fischer titration with automatic endpoint.

The results showed that the solubility of water in the more highly refined synfuels in the kerosene boiling-range was comparable to that observed for petroleum-based JP-5 fuels. The solubility of water in COED crudes derived from coal was nearly an order of magnitude greater than that in the synfuels tested.

The water solubility in eight coal-based fuels was found to be generally greater for those of higher aromatic content, as indicated by a negative correlation ($r = -0.78$) with the aniline point.

The solubility of water in the synfuels and syncrudes as determined at 25°, 35°, and 45°C was found to exhibit the same type of dependence on the temperature as is found for petroleum-based liquids. The calculated heats of solution were comparable to heats of solution of petroleum fuels of similar boiling range.

SPONSORED RESEARCH

CHEMISTRY DEPARTMENT

This study will continue as more synfuels become available for analysis and will include an effort to relate the solubility of water more specifically to fuel composition.

THE EFFECTS OF ELECTROSTATIC FIELDS ON ORIENTATION OF REACTING MOLECULES

Researcher: Midshipman 1/C Alan B. Whiting

Adviser: Associate Professor Charles F. Rowell

Sponsor: Trident Scholar Program

Dipole interactions often control the progress of a chemical reaction and the nature of the product. The imposition of a static external electric field will distort the population of dipole orientations and, in a favorable case, may show a change in the outcome of a reaction.

Such a system was found to be the reaction of dimethylfulvene with maleic anhydride. The ratio of exo- to endo-isomer was found to be modified significantly by such a field.



INDIVIDUAL LESSON RECORDINGS FOR AUDIOVISUAL RESOURCES

Researcher: Assistant Professor John V. Prestia

Videotape recordings of actual classroom sessions for each lesson of General Chemistry have been prepared. The complete package is made up of 69 programs plus 14 supplementary problem-solving sessions covering every aspect of the basic chemistry course.

These materials have already been used extensively by students wishing to make up missed classes, for hospital extra instruction, and as tutorials. The tapes have also been used, to a limited extent, in new-instructor indoctrination. Evaluation of their impact on instruction is underway.

COMPUTER APPLICATIONS TO GENERAL CHEMISTRY

Researcher: Professor Don G. Sheets

The objectives of this project are: (1) to develop computer-assisted instructional programs which stress the use of units in the solution of numerical problems; (2) to devise data-reduction procedures for use in the general chemistry laboratory experiments; (3) to develop programs for the random generation of tests and the analysis of responses; and (4) to gather information on computer applications to general chemistry currently being used by educators in other institutions.

The work has been divided into five phases. In Phase 1, a calculation mode which processes units along with numbers, and supplies miscellaneous chemical constants is developed. Currently the calculation mode is in operation, but future work involves the construction of more extensive tables of constants.

Phase 2 involves the writing of tutorial programs to be used with the calculation-mode described in Phase 1. At present eleven such programs are in operation. Many more programs covering the topics listed in the core course compendium need to be written.

Phase 3 is concerned with the development of programs for the reduction of data obtained by midshipmen in the general chemistry laboratory. Currently there are data-reduction programs available for fourteen of the experiments, some of which still need revision, and programs are needed for some of the other quantitative experiments.

Phase 4, a set of programs for the random generation of tests to be used at time-sharing terminals, as well as tests to be printed for classroom use, is being developed. These tests would draw items from a large bank of test questions. At the present time this phase is the least developed, but a program has been devised to print short quizzes for classroom use, which draw questions for the tutorial programs mentioned in Phase 2. Random test generation will be emphasized this summer in the IDP project.

In Phase 5 information was gathered on computer applications to general chemistry used by others. Valuable information was obtained at the 1978 Conference on Computers in the Undergraduate Curricula at the University of Denver and at the ACS Workshop on Computers in Chemistry, III at Montclair State College.



SCANNING ELECTRON MICROSCOPE SURVEY OF BIOLOGICAL SPECIMENS COMPATIBLE WITH THE VACUUM EVACUATOR

Researcher: Midshipman 1/C James M. Chimiak

Adviser: Assistant Professor D. Lawrence Weingartner

The Mechanical Engineering Department has a scanning electron microscope (SEM), which is normally used in metallurgical research. Non-conducting materials undergo a preparation procedure in which they are coated with an electron-dense material in a tungsten filament vacuum evacuator. The high temperatures generated by this process are harmful to many materials. In a previously published experiment, it was found that bone could be successfully prepared for SEM study by this process.

In the present study, the purpose was to undertake a SEM survey of various types of biological specimens and materials in order to determine their compatibility with the tungsten filament vacuum evacuator. There were two goals: (1) to determine what types of samples could be successfully processed, and (2) to determine the nature and extent of thermal damage to those types of samples that were not successfully processed.

The biological survey included blood, aquatic micro-organisms and plant-seedling specimens, and cartilaginous and chitinous materials. The general results were that cellular material was damaged or destroyed, while extracellular solid matrix material was compatible with the preparation process.

THE SYNTHESIS OF HETEROCYCLIC THIOCARBAZONES AS POTENTIAL ANTIMALARIALS

Researchers: Midshipmen 1/C Armando Gonzalez and Stephen D. Grant

Adviser: Professor Samuel P. Massie, Jr.

A series of heterocyclic thiosemicarbazones was prepared from 2-acetylquinoline for testing as potential antimalarials. These compounds were prepared by reacting 2-acetylquinoline with S-methyldithiocarbazate and subsequently with selected amines.

Seven compounds were prepared, and all analyzed corrected for C, H, N and S. Spectra (IR, NMR and mass) were taken and substantiated the proposed structures.

Three of the compounds have already showed favorable preliminary activity against Plasmodium Berghei (rat malaria).

EVALUATION OF AN ELECTROANALYTICAL METHOD FOR RHODIUM

Researcher: Midshipman 1/C J. R. Hashberger

Adviser: Professor Orville W. Rollins

A successful electroanalytical method for rhodium, first developed in this laboratory, was explored to establish the significance of such parameters as voltage, current, current-density, absolute amounts plated, concentrations, times etc.

A BIOASSAY OF RAT LIVER GLYCOGEN FOLLOWING ADRENALECTOMY USING AMYLOGLUCOSIDASE IN ENZYMATIC HYDROLYSIS

Researcher: Midshipman 1/C Peter A. Johnstone

Advisers: Ensign Stephanie Pluskota, USNR, and Captain Gerard Tozzi, USA

An assay-system utilizing enzymatic hydrolysis (Bergmeyer, 1974) was used to measure glycogen deposition in rat liver following adrenalectomy. Adult, male Sprague-Dawley rats were divided into four experimental groups: sham-operated without corticosterone injections (C.I.), adrenalectomized without C.I., sham-operated with C.I. (300ug, IP.) and adrenalectomized with C.I. (300ug, IP.). All rats were allowed to stabilize on an ad lib diet for seven days followed surgery. Adrenalectomized rats were given salt supplemented drinking water (0.75% NaCl). Food was withdrawn 30 hours prior to sacrifice, which took place on the eight post-operative day. Assay results showed the sham-operated rats receiving C.I. to have the highest liver glycogen content. Adrenalectomized rats with C.I. and sham-operated without C.I. had the next highest glycogen levels, while the lowest content was found in the livers of adrenalectomized rats without C.I. The data indicate that the Keppler-Decker method (in Bergmeyer) is applicable as a bioassay of rat-liver glycogen following adrenalectomy.

THE EFFECT OF COLCHICINE ON THE METABOLISM AND PLOIDY STATE OF PHALAENOPSIS SEEDLINGS

Researcher: Midshipman 1/C David K. Knab

Adviser: Assistant Professor D. Lawrence Weingartner

Two month-old seedlings (protocorm stage) of the orchid, *Phalaenopsis* x Golden Pride, were treated with the mitotic-inhibitor, colchicine, in an attempt to induce polyploidy. Seedlings were used as controls or subjected to one of five concentrations of colchicine for an eleven-day period. This was followed by a one-month recovery period in which the seedlings grew on a sterilized nutrient agar medium.

RESEARCH COURSE PROJECTS

CHEMISTRY DEPARTMENT

Results of the experimental treatment were determined by the following two methods: (1) chromosome counts were made using acetoorcein stain and the squash-method, and (2) metabolic rate changes were observed using manu-metric techniques.

ENTERIC BACTERIA OF SEA GULL FECES

Researcher: Midshipman 1/C Robert P. Larys

Adviser: Professor R. Reece Corey

This was a continuation of previous work on sea gull feces to obtain more data. Sea gull feces were macerated and diluted in sterile water. The suspension was filtered through membrane filter, which was then placed on deoxycholate agar and incubated for 48 hours. Representative colonies were subcultured on agar slants from which a suspension of bacteria in sterile water was used to inoculate API20 kits. These test the 22 characters that are used to identify enteric bacteria. The technique was identical to that used in previous years with the exception of the agar medium used for isolation.

ATTEMPTS AT DETERMINING RHODIUM BY USE OF ETHYLENEDIAMINE TETRAACETIC ACID (EDTA)

Researcher: Midshipman 1/C David M. McDonald

Adviser: Professor Orville W. Rollins

The use of an EDTA to determine rhodium by a purely volumetric technique was attempted using displacement of magnesium ions from EDTA complex. The free Magnesium ion was then titrated with EDTA using Eriochrome Black T as indicator. Although the exchange was 90% complete after boiling for one hour at various pH values, Rh(III) was sufficiently inert to make this an unsuccessful route.

ANALYSIS FOR RHODIUM BY REDUCTION FOLLOWED BY INDIRECT TITRATION

Researchers: Midshipmen 1/C Edward J. Mitenius and David L. Spain

Adviser: Professor Orville W. Rollins

An analytical approach using copper amalgam to reduce rhodium(III) to metallic rhodium (as an amalgam) followed by titration of the freed copper(II) with ethylenediamine-tetraacetic acid was attempted. It was found that the reduction step did not go to completion under the conditions employed.

SYNTHESIS OF METALLO-ORTHOHEXAPHENYLENE DERIVATIVES

Researcher: Midshipman 1/C Mark D. Seaman

Adviser: Lieutenant Thomas E. Bitterwolf, USNR

In 1972 George Wittig published the remarkable synthesis of ortho-hexaphenylene, a cyclic compound in which six benzenes are puckered into a tight ring. The geometries of the benzenes require that the benzenes fold alternatively into two cups consisting of three benzenes per cup. Pictures of this compound and later space-filling models suggest that a metal atom should be able to be accommodated within the cup, possibly creating a new, exciting new class of metallo-benzoid compounds.

An eight-step synthetic scheme was undertaken to provide the basic hexaphenylene skeleton. This tedious synthesis had several difficult steps but success was finally obtained.

DEVELOPMENT OF A NEW GAS CHROMATOGRAPHY EXPERIMENT FOR THE FRESHMAN CHEMISTRY LABORATORY

Researcher: Midshipman 1/C George Spencer

Adviser: Professor Edward Koubek

An experiment to demonstrate the phenomena of simple and fractional distillation while using gas chromatography to analyze the distillate was developed with selection of optimum mixtures and conditions sought.

PUBLICATIONS

CHEMISTRY DEPARTMENT

MONTGOMERY, Henry E., Jr., Lieutenant, USN, "One Electron Wavefunctions. Dipole Polarizabilities," Chemical Physics Letters, 56, (1978), 307-309.

Variational perturbation theory is used to calculate dipole polarizabilities for H_2^+ as a function of internuclear separation. The variational polarizabilities are used to investigate the accuracy of semi-empirical formulae for computing upper and lower bounds.

MONTGOMERY, Henry E., Jr., Lieutenant, USN, and Thomas G. RUBENSTEIN, Midshipman 1/C, "One Electron Wavefunctions. Dynamic Dipole Polarizabilities," Chemical Physics Letters, 58, (1978), 295-297.

Variational perturbation theory is used to calculate dynamic dipole of H_2^+ . The procedure locates the wavelength of the first parallel and perpendicular excitations to within 0.02 Å. Padé approximate lower-bounds are in excellent agreement with the polarizabilities calculated using variational perturbation theory.

SCHULTZ, Warren W., Lieutenant Commander, USN, "Hepatitis B Detection Systems: Sensitivity and Performance Evaluation," Military Medicine, 143, (1978), 471.

There are several third generation HB_sAg radiometric and two non-radiometric systems that are commercially available and another system (RPLA) which is undergoing licensing procedures. The RPLA, but not the EIA and RPHA, is as sensitive as the RIA methods. The RPLA, EIA, and RPHA tests are portable, less costly, do not have a radiation biohazard, and can easily be used in the field or aboard ship without RIA support-equipment. The RIA methods, however, have the advantage of being objective tests. Other aspects of test-performance for the above systems are discussed.

SCHULTZ, Warren W., Lieutenant Commander, USN, co-author, "Growth of Rickettsia typhi in Irradiated L Cells Enhanced by Lysosomal Stabilization," Infection and Immunity, 23, (1979), 61-67.

The growth of some obligate intracellular parasites is contingent upon avoidance of lysosomal activation during growth in their host cells. This is accomplished by the various parasites by different mechanisms and with different degrees of efficiency. The possibility was tested that the lysosomal stabilizer cortisone acetate might protect and thus enhance the growth of Rickettsia typhi in mouse L cells irradiated 6 days

earlier. Beginning 2 days before infection of the L cells with a multiplicity of 10 rickettsiae, 20ug of cortisone per ml was added in medium 199 containing 5% fetal calf-serum. This concentration of cortisone was below the cytotoxic level, as determined by viability staining, but was sufficient to significantly alter the ratios of cellular and released acid-phosphatase and β -glucuronidase in uninfected and infected cells, as shown by spectrophotometric analysis. Rickettsial replication, measured by hemolytic activity at 96 h and confirmed by microscopic observations at earlier stages of infection, was increased by the cortisone. Cortisone concentrations of 10 or 40 ug/ml were less effective, and cortisone was ineffective when the rickettsial multiplicity per L cell was 2 or lower. These results indicate that amounts of cortisone that increase lysosomal stabilization in L cells favor rickettsial multiplication when the multiplicity of infection is relatively high.

SNYDER, Stephen L., Lieutenant Commander, USN, co-author, "Biologic Properties of Bacterial Lipopolysaccharides Treated with Chromium Chloride," Canadian Journal of Microbiology, 24, (1978), 495.

Addition of small amounts of chromium chloride to a saline suspension of Salmonella typhosa lipopolysaccharide (LPS:Difco) caused a marked reduction in several of the biologic activities of this substance including toxicity, β -cell mitogenicity, plasma colony-stimulating activity (CSA), radioprotective effect, and induction of the dermal Shwartzman reaction. Nevertheless, LPS treated with chromium chloride was found to be at least as effective as untreated LPS in enhancing resistance of B6CBF1 mice to the lethal effects of Klebsiella pneumoniae infection.

SNYDER, Stephen L., Lieutenant Commander, USN, co-author, "Radiation-Induced Alternatives in the Distribution of Lysosomal Hydrolases in Rat Spleen Homogenates," Radiation Research, 75, (1978), 91.

Whole-body exposure of rats to ^{60}Co - γ radiation results in increases in the activities of two lysosomal hydrolases, β -glucuronidase and α -fucosidase, found in the supernatant fraction of spleen homogenates. The redistribution of these enzymes from the "particulate-bound" to the "free-supernatant" fraction of spleen homogenates has been studied as a function of radiation dose. The response curves for the ratio of free/bound enzyme versus dose are sigmoidal with maximum occurring at 300 to 400 rad.

PUBLICATIONS

CHEMISTRY DEPARTMENT

WHITING, Alan B., Midshipman 1/C, "The Effects of Electrostatic Fields On Orientation of Reacting Molecules," Trident Scholar Project Report Number 102, (1979), U.S. Naval Academy, Annapolis.

Dipole interactions often control the progress of a chemical reaction and the nature of the product. The imposition of a static external electric field will distort the population of dipole orientations and, in a favorable case, may show a change in the outcome of a reaction.

Such a system was found to be the reaction of dimethylfulvene with maleic anhydride. The ratio of exo- to endo-isomer was found to be modified significantly by such a field.



PRESENTATIONS

CHEMISTRY DEPARTMENT

GOMBA, Frank J., Associate Professor, "Computer-Augmented Video Education: Laboratory Exercises," Maryland Association for Educational Use of Computers, Towson, Maryland, 16 November 1978.

GONZALEZ, Armando, Midshipman 1/C, "The Testing of Heterocyclic Thiosemicarbazones as Potential Malarials," 1979 Intercollegiate Student Chemists Conference, Bloomsburg, Pennsylvania, April 1979.

GRANT, Stephen, Midshipman 1/C, "The Synthesis of Heterocyclic Thiosemicarbazones as Potential Malarials," 1979 Intercollegiate Student Chemists Conference, Bloomsburg, Pennsylvania, April 1979.

JOHNSTONE, Peter, Midshipman 1/C, "A Bioassay of Rat Liver Glycogen (following adrenalectomy) using Amyloglucosidase in Enzymatic Hydrolysis," Intercollegiate Student Chemists Conference, Bloomsburg, Pennsylvania, April 1979.

MASSIE, Samuel P., Professor, "Brady, Ferguson and Company," 177th National Meeting of the American Chemical Society, Honolulu, Hawaii, April 1979.

PRESTIA, John V., Assistant Professor, "Computer-Augmented Video Education (CAVE) in Troublesome Areas of Chemistry," Maryland Association for the Educational Use of Computers, Towson, Maryland, 16 November 1978.

WHITING, Alan B., Midshipman 1/C, "The Effects of Electrostatic Fields on Orientation of Reacting Molecules," 1979 Intercollegiate Student Chemists Conference, Bloomsburg, Pennsylvania, April 1979.

MATHEMATICS DEPARTMENT

Professor Theodore J. Benac, Chairman



Research has become an integral part of the professional activities of the Mathematics Department. Areas of research reflect the wide range of interest present in the staff. Present activity includes research in algebra, graph theory, harmonic functions, shape theory, non-standard analysis, category theory, differential equations, lattice theory, probability and statistics, operator theory, classical analysis, and differential geometry. A number of research projects have received support from the Naval Academy Research Council.



DEFORMATION OF ALGEBRAS

Researcher: Assistant Professor Jane P. Coffee

Sponsor: Naval Academy Research Council

The first objective of this project is to generalize the results of a previous Naval Academy Research Council grant "On the Rigidity of Algebras" to graded algebras over fields of characteristic p . In particular, the relationship between the operational and filtration structures of a graded algebra over a field of characteristic p must be studied.

The second objective is to determine algebraic analogues of the results of Nijenhuis and Richardson contained in their papers on analytic deformation theory. Specifically, the question of the existence of a rigid algebra A with $H^2(A, A) \neq 0$ must be answered for associative algebras over fields of characteristic 0 and of characteristic p .

It has been shown that for a nontrivial deformation of A over a field of characteristic p , the number of higher derivations is less than for A . It is clear, however, that the crucial question which must be answered is what form must the infinitesimal of a trivial deformation over a field of characteristic p have.

PSEUDO ANALYTIC FUNCTIONS AND APPROXIMATION THEORY FOR SOLUTIONS OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS

Researcher: Assistant Professor Allan J. Fryant

Sponsor: Naval Academy Research Council

The objective of this project is to obtain polynomial approximation results for pseudo-analytic functions which extend those found in classical complex analysis. Such results are then applied directly to the development of a corresponding approximation theory for elliptic partial differential equations.

Such a development has been completed for pseudo-analytic functions whose real and imaginary parts are ultraspherical expansions and their conjugates. Results obtained include a theory of Faber polynomial approximation, approximation by formal power interpolation, determination of the best possible rate of uniform convergence of polynomial approximations, an extension of Privaloff's theorem to pseudo-analytic functions, and a demonstration that the corresponding complex analytic results appear as a limiting case of these developments.

NILPOTENT PRODUCTS OF CYCLIC GROUPS

Researcher: Assistant Professor Anthony M. Gaglione

Sponsor: Naval Academy Research Council

Let G be a free product of a finite number of cyclic groups at least one of which is of finite order. Let G_n denote the n th subgroup of the lower central series of G . The main objective of this investigation is to find presentations for the groups of the form

$$\bar{G}_n = G_n/G_{n+1} \text{ for } n = 1, 2, 3, \dots$$

Besides using several methods of the Commutator Calculus, the investigation will exploit a generalization of the "Bracketing Process," recently developed by the researcher. The latter should help to cope with a very difficult independence argument involved with generators of certain subgroups of the groups under consideration. At this point, it is reasonable to conjecture that the "generalized" bracketing process will allow the complete determination of all the groups \bar{G}_n for $1 \leq n \leq 2p$, where p is the smallest prime which divides the order of any generator of G .

BASIC ELEMENTS IN GRADED MODULES

Researcher: Assistant Professor Charles C. Hanna

Sponsor: Naval Academy Research Council

The purpose of this project is to investigate analogues of the Eisenbud-Evans theorem on basic elements in context of graded modules over graded rings. The goal is a condition or set of conditions on a collection of homogeneous prime ideals of a graded ring A and on a graded A -module M sufficient to guarantee the existence of a homogeneous element x of M basic in M at each of the primes. Consequences of such a theorem will also be explored.

To date the case $A = k[X, Y]$, polynomials in two variables over a field, has been completely investigated, and some progress has been made in a more general context. Applications, both of the partial result and of the conjectured theorem to vector bundles on projective spaces, have been discovered.

HOMOMORPHISMS OF THE BANACH ALGEBRA ℓ_+

Researcher: Assistant Professor Charles H. Heiberg

Sponsor: Naval Academy Research Council

The objective of this project is to improve results known about the homomorphisms of the Banach algebra of all absolutely convergent power series in n variables. This work will employ a generalization of the concept of homogeneous polynomial. It is anticipated that some new results about polynomials will be obtained.

The problem of characterizing the homomorphisms of ℓ_+ is equivalent to the problem of characterizing those elements of ℓ_+ whose m -th power remains bounded in norm as m approaches infinity. It is known that existence of this boundedness depends only on the local behavior of the element of ℓ_+ about each of its maxima of the n -fold Cartesian product of the unit circle with itself. The investigator proposes to use the Taylor development of $\log f$ about each of these maxima in order to estimate the norm of the m -th power of f as m tends to infinity.

To date, results known to hold in the one-variable case have been re-proved in such a way that an extension to many variables appears possible. Work on this extension is in progress.

CLOSED GRAPH THEORY AND CONVERGENCE SPACES

Researcher: Assistant Professor Robert A. Herrmann

Sponsor: Naval Academy Research Council

In this research, closed graph theory and its relation to convergence spaces is to be investigated. The investigator's basic method will continue to be nonstandard topology with respect to an enlarged model. In particular, the nonstandard theory of filterbases on a meet-semi-lattice of sets is to be employed. All results will be translated into standard convergence space terminology.

Thus far three major results have been obtained. A map f from a space (X, p) into the space (Y, q) has a closed graph if and only if whenever a filter F is p -convergent to x and $f(F)$ is q -convergent to y , then $f(x) = y$. If a map f from (X, p) into (Y, q) has a closed graph and Y is compact, then f is weakly-continuous. Let S be the class of all Hausdorff, completely normal, fully normal, door spaces and $Y \in T_1$. If for each member X of S , each bijection from X onto Y with a closed graph is weakly-continuous, then Y is compact.

DEFORMATIONS AND RIGIDITY OF SUBMANIFOLDS OF CONSTANT MEAN CURVATURE

Researcher: Assistant Professor Dominic S. P. Leung

Sponsor: Naval Academy Research Council

The objectives of this project are to show (a) that any Jacobi field on a closed geodesic of a Riemannian manifold of positive curvature is integrable, (b) that any Jacobi field on a compact minimal surface in the n -dimensional sphere is integrable, (c) that a compact 2-dimensional submanifold of an n -dimensional manifold of constant curvature, which has constant mean curvature and is topologically a sphere, is either flat, totally umbilical or a minimal surface.

The first objective will be approached by studying the Poincare mapping associated with the geodesic. For the integrability of Jacobi fields on a compact minimal submanifold M of an n -dimensional sphere, the problem can be reduced to the construction of a suitable one-parameter family of solutions of an integral equation defined on the normal bundle M .

ANALYTICAL PROPERTIES OF SOLUTIONS TO SOME SECOND ORDER LINEAR PARTIAL DIFFERENTIAL EQUATIONS

Researcher: Associate Professor Peter A. McCoy

Sponsor: Naval Academy Research Council

The object of this research is to determine global characterizations of singularities of solutions and growth of entire function solutions of some second order elliptic partial differential equations. Those equations under consideration arise in certain applications including compressible fluid flow.

The global information is stated in terms of the growth of sequences of error bounds. These are generated by local approximation of the solution in Chebyshev norm over classes of complete sets of solutions which generalize harmonic polynomials and Newtonian potentials. The study proceeds via integral transforms and methods of classical analysis which transform corresponding information on the singularities and growth of analytic functions of a single complex variable. The project is continuing.

INTERPLAY BETWEEN TOPOLOGY AND GEOMETRY

Researcher: Assistant Professor Mark D. Meyerson

Sponsor: Naval Academy Research Council

The objective of the project is to study, unify, and solve several problems which are of special interest because they are simultaneously topological and geometrical, and to consider geometric approaches to topological problems. Examples of results in these areas include a geometric proof of the Borsuk-Ulam Theorem, an example showing that some tame knots cannot be linked by a straight line, Roger Fenn's Table Theorem, and results on dilations.

It is hoped that the methods used by the investigator in a co-authored paper can be combined to attack several of these problems. In addition, the investigator will try to develop new techniques where needed.

Up to this point, effort has been focused on compiling work and sources in the field and attempting to unify several related problems. The investigator has tried his techniques on several very specific problems to get a better understanding of more general situations. It is hoped that a single approach can be used on many related problems.

SOME CLASSES OF FUNCTIONS RELATED TO THE ROBERTSON FUNCTIONS

Researcher: Assistant Professor Edward J. Moulis, Jr.

Sponsor: Naval Academy Research Council

The objective of this research project is to study certain analytic and geometric properties of some large classes of functions regular in the unit disk. Since the early part of this century, useful information--such as distortion and rotation bounds, coefficient bounds, and bounds on the Schwarzian derivative--has been obtained for the class of functions mapping the unit disk onto a convex domain. By a suitable selection of real parameters, it is possible to define larger classes of functions, with each parameter referring to a specific geometric property. The researcher is investigating how and in what natural setting this information can be extended to these large classes of functions.

SMALE THEOREM IN CG-SHAPE

Researcher: Associate Professor Thomas J. Sanders

Sponsor: Naval Academy Research Council

The objective of this project is to develop an analogue of a classical theorem of S. Smale in compactly-generated shape theory and thereby extend the results of this theorem into a more general setting. In particular, conditions are sought under which a continuous function will induce bimorphisms on homotopy bi-groups.

THE SPECTRUM OF A GRAPH; ENUMERATION; RAMSEY THEORY

Researcher: Assistant Professor Allen J. Schwenk

Sponsor: Naval Academy Research Council

The purpose of this project was to study three areas of graph theory. Primary objectives included developing methods for constructing cospectral graphs, generalizing ramsey theory to treat networks, and the solution of specific enumeration problems. The project has been completed after three years of support.



GENERALIZED FACTORIAL SERIES EXPANSIONS OF SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS NEAR IRREGULAR SINGULAR POINTS

Researcher: Associate Professor James M. D'Archangelo

Many ordinary differential equations arising from Mathematical-Physics have solutions near irregular singular points which are characterized by formal asymptotic power series which are in general divergent. The accuracy that can be attained in computing the values of a solution is definitely limited when an asymptotic series representation is used. H. L. Turrittin was able, in some cases, to obtain convergent generalized factorial series expansions of solutions near an irregular singular point. These are preferred over the asymptotic series, because any desired degree of accuracy can be obtained by using the convergent factorial series solution.

The method of obtaining generalized factorial series expansions of actual solutions which converge in a neighborhood of an irregular singular point is to do the decomposition of an original system of linear differential equations whose solutions are expressed in terms of Laplace transforms.

An objective of this project is to extend the results of Turrittin by applying the researcher's work on Laplace transform representations of solutions of differential equations.

Another objective is to do a numerical study of the usefulness (computability) of the convergent factorial series solutions.

HIGHER DERIVATIONS AND FIELD EXTENSIONS

Researcher: Assistant Professor Richard L. Davis

Let h be a subfield of the field K with nonzero characteristic p and set $W = \bigcap_n K^{p^n}(h)$. It is known that h is the field of constants of an infinite higher derivation in K if and only if K/h is separable and $W = h$. Originally this study sought to obtain an alternate description of the fields of constants of higher derivation. The study has broadened to a study of subfields h of K having the property that $W = h$. The finite generation case has been discussed in recent publications. Among the observations made in this study are the following:

1. If K/h is arbitrary, then the separable algebraic closure of h in K is contained in W , and W is separably algebraically closed in K .
2. If K/h is separable, then W is the field of constants of an infinite higher derivation in K and therefore is algebraically closed and coseparable in K .

3. If K/H is separably generated, then the algebraic closure of h in K equals W .

4. S is a p -basis for K/h if and only if S is a p -basis for K/W .

COVERING PROPERTIES OF LINEARLY ORDERED TOPOLOGICAL SPACES

Researcher: Assistant Professor Marlene E. Gewand

The object of this project is to characterize covering properties of linearly ordered topological spaces. A technique has been devised which appears to be quite useful in this investigation. By relying heavily on the linear order of the space, we are able to define many equivalence relations. Examination of the resulting quotient spaces tends to clarify the problems and to provide information about the original space.

This technique has been used to characterize the Lindelöf degree of a linearly-ordered space. It has also been used to determine the Lindelöf degree of the product of a linearly-ordered space with any other Lindelöf space.

Of particular interest is an equivalence relation defined in terms of the scattered-like decomposition of intervals. The Lindelöf property, or paracompactness, of a product of a Lindelöf, or paracompact, linearly-ordered space X with any other Lindelöf, or paracompact, space Y is closely related to the covering properties of the product of the quotient space of X with the space Y . This quotient space as well as spaces determined by other equivalence relations will continue to be studied.

SYSTEMS OF QUADRATIC FORMS - A HASSE PRINCIPLE

Researcher: Assistant Professor JoAnn Turisco

This work concerns a generalization to several forms of some of the results in the theory of one quadratic form. It involves studying quadratic mappings of spheres, with emphasis on a special type, called a Hopf map. As a kind of generalization of quadratic forms and the orthogonal group, the automorphisms of these Hopf maps are being computed. There is the well-known theorem of Hasse-Minkowski for quadratic forms which states that two quadratic forms are equivalent over a global field K if and only if they are equivalent over the completion K_v , for each place v . An objective is to prove a similar "Hasse Principle" for Hopf maps, using results in the theory of Galois

cohomology. A special case of this problem was recently solved by Ono in the case where the Hopf maps are associated to the "composition algebras" over a field K . Some results in a more general setting have been obtained using methods involving Clifford algebras and their representations. The project is ongoing.

DIRECT METHODS OF NONPARAMETRIC DISCRIMINATION

Researcher: Assistant Professor John C. Turner

The objective of this project is to develop nonparametric discriminant functions. This is an extension of previous work by the author in which discriminant functions were based on nonparametric probability density function estimates. The present work is aimed at directly estimating the discriminant function. It is felt that this will lead to more reliable and more accurate estimates. This work is just underway, and the literature search has been completed.

OPTIMAL DESIGN OF MULTI SPECTRAL SENSORS

Researcher: Assistant Professor John C. Turner

The objective of this project is to develop an algorithm for the selection of the spectral bands that are best to observe in order to distinguish from among a number of possible sources. The first stage, essentially completed, is to develop the appropriate computer program based on certain probabilistic assumptions and evaluate the effect of certain search parameters. The second stage, currently underway, is to validate the probabilistic assumptions using real data collected from NASA.

CARDINALITY AND STRUCTURE OF STRICTLY n -ASSOCIATIVE GROUPOIDS

Researcher: Assistant Professor William P. Wardlaw

In 1970, the investigator obtained the following generalization of the generalized associative law: let G be a groupoid and n an integer greater than 2. Then G n -associative implies G is $(n+1)$ -associative. (A groupoid G is defined to be n -associative if every product of n factors in G is independent of the way in which the factors are associated.) This result motivated the study of strictly n -associative groupoids, that is, groupoids which are n -associative but not $(n-1)$ -associative. A number of examples of such groupoids and

some rudimentary results concerning their cardinalities were obtained early in the investigation.

In 1972, the investigator used a computer to obtain new examples of strictly n -associative groupoids. These examples led to the discovery of results concerning the structure and cardinalities of strictly n -associative groupoids.

A new approach to the problem led to improved results on the cardinalities of strictly n -associative groupoids. These results were further sharpened to yield the following:

Theorem. Let G be a strictly m -associative groupoid with finite cardinality $|G| = k$. Then $m \leq 2^{k-2} + 1$.

The continuation of this project involves the determination of all possible cardinalities of strictly m -associative groupoids, the investigation of the structure of such groupoids, and the extension of these results to finite dimensional algebras.



CHAMBERLAIN, Michael W., Assistant Professor, "Rencontre as an Odd-Even Game," Mathematics Magazine, 51, (1978), 240-244.

Rencontre is an old probability problem, dating back to the mathematician Montmort (1708), one which has undergone many variations and generalizations. This paper discusses the problem in the manner that Schuster and Philippou discussed odd-even games for the Bernoulli and Poisson probability models; that is, rencontre is restated as a game for three opponents. However, the mathematical analysis of the game is complicated by the lack of statistical independence. This author (re)discovered a recurrence relation which is the key to the solution. Included in the solution are: an analysis of the properties of the probabilities of winning for the opponents, algorithms for computing these probabilities, and partial tables of these probabilities prepared with the USNA Honeywell H635 computer.

FRYANT, Allan J., Assistant Professor, "Extension of Privaloff's Theorem to Ultraspherical Expansions," Proceedings of the American Mathematical Society, 71, (1978), 49-53.

The classical theorem of Privaloff which relates the boundary continuity of the real part of an analytic function to that of its harmonic conjugate is extended to ultraspherical expansions. These are expansions in Gegenbauer polynomials which arise in the study of potential theory on a disk in two and higher dimensions. Sufficient conditions on an ultraspherical series which ensure that its conjugate series converges to a continuous function are obtained. It is shown that Privaloff's Theorem appears as a limiting case of the result obtained.

FRYANT, Allan J., Assistant Professor, "Growth and Complete Sequences of Generalized Bi-Axially Symmetric Potentials," Journal of Differential Equations, 31 (1979), 155-164.

The growth of entire generalized bi-axially symmetric potentials is characterized explicitly in terms of its coefficients in a Jacobi polynomial expansion. Using the Braahsma-Muelenbeld Laplace type integral for the Jacobi polynomials, this result is then used to obtain a method for generating complete sequences of solutions to the bi-symmetric potential equation from a single entire solution. The work thus represents the extension of well-known results from classical complex analysis to solutions of elliptic partial differential equations.

FRYANT, Allan J., Assistant Professor, "Growth of Entire Harmonic Functions in R^3 ," Journal of Mathematical Analysis and Applications, 66 (1978), 599-605.

The Bergman B_3 integral operator is used to investigate the growth of entire harmonic functions in three dimensions. It is shown that the order of an entire harmonic function equals the order of its B_3 associate. Best possible upper and lower bounds relating the type of a harmonic function to the type of its associate are found. Application is made to obtain explicit expressions for the order and bounds on the type of an entire harmonic function in terms of its coefficients in a spherical harmonic expansion.

FRYANT, Allan J., Assistant Professor, "Interpolation and Approximation of Generalized Axisymmetric Potentials," Society of Industrial and Applied Mathematics, Journal of Mathematical Analysis, 9 (1978), 906-914.

By drawing on classical complex analysis, results regarding the uniform polynomial approximation of generalized axisymmetric potentials are obtained. These functions arise as symmetric solutions of Laplace's equation in three dimensions, as well as in various areas of continuum mechanics, such as gas dynamics, and the study of elasticity. Results obtained include an analog of Runge's theorem in which it is shown that the polynomial approximants can be chosen so as to converge at a geometric rate, determination of the maximal degree of this convergence, solution of the Dirichlet problem for the symmetric potential equation by polynomial interpolation to boundary values, and development of polynomial approximants which enjoy the expansion properties associated with the classical Faber polynomials. The approximants used are in all cases generalized axisymmetric polynomials; that is, polynomial solutions of elliptic differential equation.

HANNA, Charles C., Assistant Professor, "Subbundles of Vector Bundles on the Projective Line," Journal of Algebra, 52, (1978), 322-327.

A vector bundle on the projective line over a commutative ring with unit R is a pair (P, f) , where P is a finitely-generated projective R -module and f is an $R[x, 1/x]$ -automorphism of the tensor product of P by $R[x, 1/x]$. $O(n)$ is the vector bundle (R, f_n) , where f_n is multiplication by x^n . It is shown that a vector bundle F on the projective line over R has some $O(n)$ as a subbundle under any of the following conditions:

(1) $R[x, 1/x]$ is J-neotherian of finite J-dimension d and the rank of F exceeds $d+1$.

(2) R is a principal ideal domain and the rank of F is at least three.

(3) R is a euclidean domain.

(4) It is conjectured that the result holds also if R is J-neotherian of finite J-dimension d and the rank of F exceeds $d+1$.

HERRMANN, Robert A., Assistant Professor, "Convergence Space and Perfect Maps," Mathematical Reports of the Academy of Sciences of Canada, 1 (1979), 145-148.

The purpose of this paper is to summarize some major results which have recently been obtained in the theory of generalized perfect maps.

HERRMANN, Robert A., Assistant Professor, "The Nonstandard Theory of Semi-uniform Spaces," Zeitschrift für Mathematische Logik and Grundlagen der Mathematik, 24 (1978), 237-256.

In 1951, Morita defined a generalization for uniform structures using the covering concepts of Tukey. In 1973, Steiner further developed Morita's concept of the regular T-uniformities and claimed that semi-uniformity is the fundamental structure for regular spaces. One of the goals of this paper is to strengthen this claim and to further investigate the analogies between semi-uniform and uniform structures. These analogies are particularly apparent when these structures are studied from the nonstandard viewpoint. Fenstad and Nyberg, Henson, Luxemburg and Machover-Hirschfeld extensively develop the nonstandard theory of uniform spaces using the usual axiom system essentially created by Weil. Since a uniform space is semi-uniform and the latter is defined by covering properties, then this nonstandard development by means of covering theory will stand in contrast to these previous nonstandard investigations of uniform spaces. It is also shown that in many respects the covering theory approach is actually simpler from the nonstandard viewpoint than is the Weil procedure.

HERRMANN, Robert A., Assistant Professor, "Point Monads and P-closed Spaces," Notre Dame Journal of Formal Logic, 20 (1979), 395-400.

A. Robinson was the first to show that a space X is compact if and only if $*X$ is the union of its associated monads. The present author has shown that a space X is quasi-H-closed (and H-closed) if and only if $*X$ is the union of its associated theta-monads and that a space X is almost completely regular Hausdorff-closed if and only if $*X$ is the union of its associated alpha-monads. The major goal of this paper is to define a new monad, the w-monad, and to show that a space X is completely Hausdorff-closed if and only if $*X$ is the union of its associated w-monads. Following this characterization, numerous results are obtained by application of w-monad theory.

HERRMANN, Robert A., Assistant Professor, "The Productivity of Generalized Perfect Maps," Journal of the Indian Mathematical Society, 41 (1977), 375-386.

In a previous paper, a generalization of Whyburn's "directed towards" concept is investigated. It is shown that many of Whyburn's results and those for the Dickman and Porter modification as well as for perfect maps hold for this generalization. The framework for this investigation is nonstandard topology. The nonstandard definitions for (tH, sK) -continuous maps, tH -closed sets, tHA -compactness, (tH, sK) -perfect maps, etc., which are necessary to properly discuss "perfect"-type maps, allow one to retain the infinitesimal concepts usually associated with various generalizations for continuous maps, closed sets, compactness, etc., which appear in the literature, without the necessity of introducing distinct definitions for these generalizations. This approach not only develops many of the standard results as a by-product but employs the economy of effort which is inherent within nonstandard topology. One of the more important reasons for using nonstandard topology is that many concepts which often appear dissimilar within the standard model are not only clarified and made more concise when investigated from the nonstandard viewpoint but often show a remarkable similarity. In this paper, nonstandard methods are used to show that the product of generalized perfect maps is a perfect map and the ramifications of this result are fully investigated.

HERRMANN, Robert A., Assistant Professor, "Theta-Rigidity and the Idempotent Theta-closure," Mathematics Seminar Notes, 6 (1978), 217-220.

The following major problem is suggested in a recent paper by Dickman and Porter: "Characterize those topological spaces with the property that for each subset B of the space X , $cl\,cl_0(B) = cl_0(B)$. It is shown in this paper that the following statements are equivalent: (a) The operator cl_0 is idempotent on the topology T of X . (b) The space (X, T) is almost-regular. (c) The operator $cl_0 = cl_{XS}$. (d) The operator cl_0 is idempotent on $P(X)$. These results completely solve the above-suggested problem.

McCOY, Peter A., Associate Professor, "Analytical Properties of Generalized Biaxially Symmetric Potentials," Journal of Applicable Analysis, 8 (1978), 201-209.

The classical solutions to the generalized biaxially symmetric potential F equation subject to certain Cauchy data along singular lines are expanded as Fourier series in terms of a complete set of normalized biaxially symmetric harmonic polynomials. The coefficients of these expansions characterize the singularities and zeros of F . R. P. Gilbert utilized operators based on Gegenbauer's integral for Jacobi polynomials and the envelope method to obtain Hadamard and Mandelbrojt classifications of the singularities. We establish Caratheodory - Toeplitz and Schur classifications of the zeros by means of convexity arguments and operators based on Koornwinder's new LaPlace-type integral for Jacobi polynomials.

McCOY, PETER A., Associate Professor, "Polynomial Approximation and Growth of Generalized Axisymmetric Potentials," Canadian Journal of Mathematics, 31 (1979), 49-59.

Let the real-valued generalized axisymmetric potential F be regular in the open unit hypersphere and continuous on the closure. The minimum errors in the Chebyshev approximation of F on the closed sphere are taken over classes of real axisymmetric harmonic polynomials. The growth of the error sequence determines those F which harmonically continue as entire functions. In these cases, the order and type of F are defined as in function theory and are computed from the error sequence.

These may be interpreted as generalizations of S. N. Bernstein's and R. S. Varga's theorems concerning necessary and sufficient conditions for a real function continuous on a segment of the real axis in the complex plane, to continue analytically as an entire function. The method of generalization is based on the Bergman and Gilbert Integral Operator Methods.

MEYERSON, Mark D., Assistant Professor, "The Impossibility of Trisecting Angles," Pi Mu Epsilon Journal, 6 (1979), 568-575.

This is an expository article giving an elementary and brief proof of the impossibility of trisecting angles and of squaring the circle.

MEYERSON, Mark D., Assistant Professor, "A New and Constructive Proof of the Borsuk-Ulam Theorem," Proceedings of the American Mathematical Society, 73 (1979), 134-136.

The classical Borsuk-Ulam Theorem states that if f is a continuous function from S^n to E^n then for some pair of antipodal points, x and $-x$, $f(x) = f(-x)$. We give an elementary constructive proof of this theorem. When f is piecewise linear the proof is constructive in every sense; it is even easily implemented on a computer.

MOULIS, Edward J., Jr., Assistant Professor, "Generalizations of the Robertson Functions," Pacific Journal of Mathematics, 80 (1978), 32-40.

A class of analytic functions is studied which unifies a number of classes previously studied, including functions with boundary rotation at most k , functions convex of order α and the Robertson functions, i.e., functions f for which zf' is α -spirallike. Representation theorems are obtained for this general class, and using a simple variational formula, also obtained sharp bounds on the modulus of the second coefficient of the series expansion of these functions. Using a univalence criterion due to Ahlfors a condition on the parameters k , α , and β is determined which will ensure that a function in this class is univalent. This result improves previously published results for various subclasses and is sharp for the class of functions f for which zf' is α -spirallike or order α .

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SUMMARY OF RESEARCH ACTIVITIES. ACADEMIC DEPARTMENTS, 1979-1980--ETC(U)

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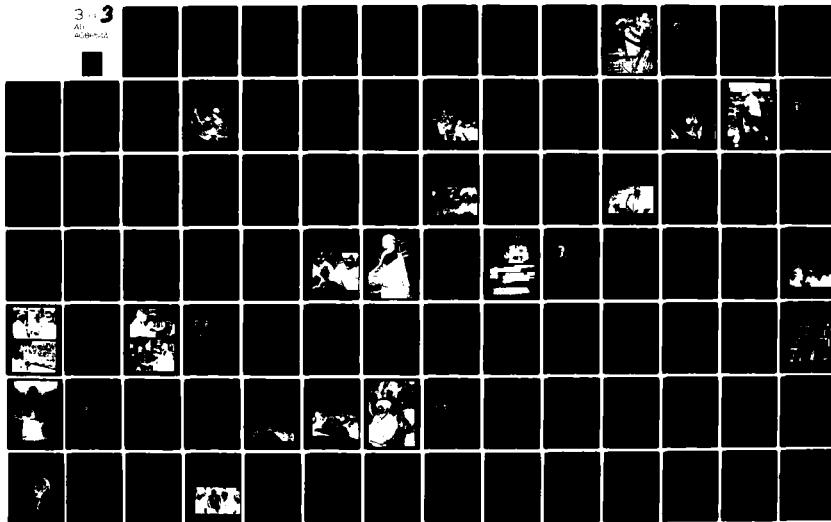
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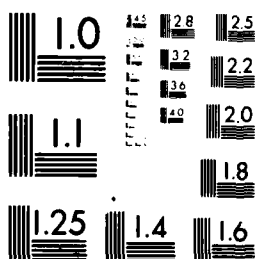
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SANDERS, Thomas J., Associate Professor, "A Finiteness Condition in CG-shape," Topology Proceedings, 3 (1978).

It is shown that if a Hausdorff space fails to be locally compact at a point at which it has a countable local base, then the space cannot be CS-finite. An application is that the concepts of locally compact and CS-finite are equivalent for metrizable spaces.

SCHWENK, Allen J., Assistant Professor, co-author, "Generalized Ramsey Theory for Graphs VII. Ramsey Theory for Multigraphs and Networks," Networks, 8 (1978), 209-216.

Ramsey problems are examined for each possible variety of graphs and digraphs, with and without loops and multiple edges, and even for networks. In every case, the resulting ramsey number either fails to exist, or has a trivial value, or equals the value for the underlying graph or digraph. Thus, there are no interesting ramsey problems for multigraphs.

SCHWENK, Allen J., Assistant Professor, co-author, "On the Eigenvalues of a Graph," Selected Topics in Graph Theory. London: Academic Press, 1978, 307-336.

This article provides an up-to-date survey of what is known about the spectrum of a graph.

SCHWENK, Allen J., Assistant Professor, "Spectral Reconstruction Problems," Advances in Graph Theory, Annals of the New York Academy of Sciences, (1979), 181-187.

Consideration of spectra leads to four variations of the usual vertex deletion reconstruction conjecture. One is just the standard problem, which, of course, remains unsolved. Another has a positive resolution due to Tutte. The third version is shown herein to be non-reconstructible. The fourth variation remains open. Corresponding problems with analogous results are found for the edge deletion reconstruction conjecture.

TURISCO, JoAnn, Assistant Professor, "Quadratic Mappings of Spheres," Linear Algebra and its Applications, 23 (1979), 261-274.

In this paper basis-free methods are obtained for determining the general form of quadratic maps over \mathbb{R} between spheres. It is shown that all quadratic maps (over certain \mathbb{R} -lattices) between spheres are Hopf maps, and that the classical Hopf fibrations, $S^{2m-1} \rightarrow S^m$, for $m = 2, 4, 8$ are the unique nontrivial maps over \mathbb{Z} , up to action by the orthogonal group.

TURNER, John C., Assistant Professor, co-author, "Nonparametric Detection Scheme for Myocardial Infarction," Journal of Medical Systems, 2 (1978), 203-212.

Bernstein et al. have suggested a method for the detection of myocardial infarction using the combined measurement of serum LD activity and inhibition of LD by pyruvate (which depends on the amount of LD from damaged myocardium). This is another in the growing number of applications of discriminant analysis in medical diagnosis. As is often the case, the true underlying distribution of the data is not known. In this case, in particular, an attempt is made at defining the distribution to more accurately assess those patients among whom the diagnosis of myocardial infarction is suspect but is not clearly identified. Tsokos and Welch have shown that discriminant procedures based on incorrect assumptions of the underlying distribution led to substantially higher error rates. This paper considers the application of a nonparametric probability density estimator recently developed by David W. Scott. This leads to a rather accurate discriminant procedure that is applicable to many other types of data.

TURNER, John C., Assistant Professor, "The Conditional Distribution of Waiting Time Given Queue Length in a Computer System," The Computer Journal, 22 (1978), 57-62.

The problem to be considered here is the determination of the conditional distribution of the waiting-time given the queue length in a computer system. There are numerous uses for such a conditional distribution. One would be a service to the users of the computer system; this would indicate to the users when their job would be ready to be picked up. Another use is as a measure to system performance; the distribution of waiting time could be a criterion for the choice of system scheduling parameters or as a measure of the impact on the system of other changes such as the addition of hardware.

Previous work on computer system performance measurement and modeling includes Bard (1971). Bard models the overhead in a time-sharing system for insight into the system. His model is based on low-level measurements such as machine instructions and supervisor calls. Lassettre and Scherr (1972) and Anderson and Sargent (1972) also deal with models of time-sharing systems. To the author's knowledge, these same techniques have not been applied to batch systems.

The general approach taken here is data-based. An examination of data from a particular computer system leads to the consideration of a model for the desired distribution. Section 2 contains an examination of the data. In Section 3, a model for the distribution of waiting time is proposed and a procedure to estimate its parameters is proposed. Section 4 contains another method of fitting distributions.

WARDLAW, William W., Assistant Professor, "Computer-Aided Intuition in Abstract Algebra," Computers and Education, 2 (1978), 247-257.

Two examples are given in which the computer was used to supplement intuition in abstract algebra. In the first example, the computer was used to search Cayley tables of 4 element groupoids to find those which are 5-associative but not 4-associative. (n-associative means that the product of any n elements is independent of the way the factors are grouped by parentheses.) The computer-generated examples suggested the existence of n element groupoids which are $(2^{n-2} + 1)$ -associative but not (2^{n-2}) -associative, for each integer n greater than 3.

In the second example, the computer counted the numbers $g(m)$ of invertible 2×2 matrices with entries chosen from the ring of integers mod m, for $m = 2, 3, 4, \dots, 18$. The insight gained from these results led to a proof that the number of invertible n by n matrices over the ring of integers mod m is given by the product

$$m^{n^2} \prod (1-p^{-1}) \cdots (1-p^{-n}),$$

where the product is over all prime divisors p of m.

PRESENTATIONS

MATHEMATICS DEPARTMENT

ANDRE, Peter P., Assistant Professor, "APSURF Validation," 41st Symposium of the Military Operations Research Society's Special Session on Validation, Fort McNair, Washington, D.C., July 1978.

ANDRE, Peter P., Assistant Professor, "Split Subgroups of Semisimple Algebraic Groups," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 24 January 1979.

FRYANT, Allan J., Assistant Professor, "Polynomial Approximation to Solutions of Elliptic Partial Differential Equations," Regional Conference on Approximation Theory, Kingston, Rhode Island, 12 June 1978.

FRYANT, Allan J., Assistant Professor, "Pseudo Analytic Functions and Ultraspherical Expansions," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 24 January 1979.

FRYANT, Allan J., Assistant Professor, "Spherical Harmonic Expansions," 765th Meeting of the American Mathematical Society, New York City, 19 April 1979.

FRYANT, Allan J., Assistant Professor, "Symmetric Potentials, Pseudo Analytic Functions and Ultraspherical Expansions," National Science Foundation Conference on Special Functions and their Relations with the Representation of Lie Groups, Greenville, North Carolina, 5 March 1979.

GAGLIONE, Anthony M., Assistant Professor, "A Commutator Identity," 82nd Summer Meeting of the American Mathematical Society, Providence, Rhode Island, 11 August 1978.

GAGLIONE, Anthony M., Assistant Professor, "A Generalization of a Theorem of P. Hall to Nilpotent Products," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 27 January 1979.

PRESENTATIONS

MATHEMATICS DEPARTMENT

GAGLIONE, Anthony M., Assistant Professor, "The Generalized Bracketing Process," 765th Meeting of the American Mathematical Society, New York City, 19 April 1979.

GEWAND, Marlene E., Assistant Professor, "Covering Properties of the Products of Topological Spaces," Ohio University Topology Conference, Athens, Ohio, 15 March 1979.

GEWAND, Marlene E., Assistant Professor, "A Technique Involving Cardinal Functions on Linearly Ordered Topological Spaces," Virginia Academy of Science Session of Invited Papers on Research Techniques in Point Set Topology, Richmond, Virginia, 11 May 1979.

HARTIG, Donald G., Assistant Professor, "A Banach Space Characterization of Local Connectedness," 756th Meeting of the American Mathematical Society, New York City, 19 April 1979.

HEIBERG, Charles H., Assistant Professor, "Extrema for Functions of Several Variables," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 27 January 1979; and Regional Meeting of the Mathematical Association of America, Fairfax, Virginia, 21 April 1979.

HEIBERG, Charles H., Assistant Professor, "Fourier Series with Bounded Convolution Powers," 82nd Summer Meeting of the American Mathematical Society, Providence, Rhode Island, 11 August 1978.

HEIBERG, Charles H., Assistant Professor, "Limits of Norms of Powers of Absolutely Convergent Fourier Series in Several Variables," 762nd Meeting of the American Mathematical Society, Chicago, Illinois, 12 November 1978.

HERRMANN, Robert A., Assistant Professor, "A Non-standard Approach to Pseudotopological Compactifications," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 27 January 1979.

PRESENTATIONS

MATHEMATICS DEPARTMENT

HERRMANN, Robert A., Assistant Professor, "Theta-Rigidity and the Idempotent Theta-Closure," 82nd Summer Meeting of the American Mathematical Society, Providence, Rhode Island, 11 August 1978.

LEUNG, Dominic S. P., Assistant Professor, "Classification of Real Forms of Hermitian Symmetric Spaces," 82nd Summer Meeting of the American Mathematical Society, Providence, Rhode Island, 11 August 1978.

LEUNG, Dominic S. P., Assistant Professor, "On the Local Existence and Deformations of Submanifolds with Constant Mean Curvature in a Riemannian Manifold," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 24 January 1979.

McCOY, Peter A., Associate Professor, "Applications of Function Theory in Electro Optics," Regional Meeting of the American Mathematical Society, Charleston, South Carolina, 14 November 1978.

McCOY, Peter A., Associate Professor, "Approximation of Axisymmetric Potentials," Regional Conference on Approximation Theory, Kingston, Rhode Island, 12 June 1978.

McCOY, Peter A., Associate Professor, "A Bernstein Theorem for a Class of Elliptic Equations in E^3 ," 82nd Annual Summer Meeting of the American Mathematical Society, Providence, Rhode Island, 12 August 1978.

McCOY, Peter A., Associate Professor, "Best L^p Approximation of Generalized Biaxially Symmetric Potentials," 765th Meeting of the American Mathematical Society, New York City, 14 April 1979.

McCOY, Peter A., Associate Professor, "The Effect of Boundary Data on Analytical Properties of Solutions to an Elliptic Equation in the Plane," Conference on Konstruktive Verfahren in der Komplexen Analysis, Mathematisches Forschungsinstitut Oberwolfach, Freiburg, West Germany, 15 August 1978.

PRESENTATIONS

MATHEMATICS DEPARTMENT

McCOY, Peter A., Associate Professor, "Global Characterizations of Biaxially Symmetric Potentials via Best Local Approximates," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 19 January 1979.

McCOY, Peter A., Associate Professor, "Local Approximation and Analytic Continuation of Solutions to a Class of Elliptic Equations in E^3 ," International Congress of Mathematicians, Helsinki, Finland, 24 August 1978.

MEYERSON, Mark D., Assistant Professor, "A New and Constructive Proof of the Borsuk-Ulam Theorem," Ohio University Topology Conference, Athens, Ohio, 16 March 1979.

MOULIS, Edward J., Jr., Assistant Professor, "A Class of Functions Containing Functions with Positive Real Part," 761st Meeting of the American Mathematical Society, Charleston, South Carolina, 14 November 1978.

MOULIS, Edward J., Jr., Assistant Professor, "Integral Representations for Classes of Analytic Functions," Regional Meeting of the Mathematical Association of America, Annapolis, Maryland, 16 November 1978.

MOULIS, Edward J., Jr., Assistant Professor, "The Modulus of the Schwarzian Derivative for Several Classes of Analytic Functions," 765th Meeting of the American Mathematical Society, New York City, 20 April 1979.

MOULIS, Edward J., Jr., Assistant Professor, "Two Classes of Analytic Functions Depending on Three Real Parameters," 82nd Annual Summer Meeting of the American Mathematical Society, Providence, Rhode Island, 12 August 1978.

PENN, Howard L., Assistant Professor, "Heat Equation in a Metal Bar," Regional Meeting of the Mathematical Association of America, Annapolis, Maryland, 18 November 1978.

PRESENTATIONS

MATHEMATICS DEPARTMENT

PENN, Howard L., Assistant Professor, "An Isomorphism Between H^P of the Polydisc and H^P Defined on Other Semigroups," 761st Meeting of the American Mathematical Society, Charleston, South Carolina, 3 November 1978.

ROGERS, Donald D., Assistant Professor, "On Fuglede's Theorem and Operator Topologies," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 24 January 1979.

SANDERS, Thomas J., Associate Professor, "Induced Shape Morphisms," Conference on Geometric Topology, Warsaw, Poland, August 1978.

SCHWENK, Allen J., Assistant Professor, "On Unimodal Sequences of Graphical Invariants," 2nd Michigan Graph Theory Symposium, Kalamazoo, Michigan, 4 November 1978.

SCHWENK, Allen J., Assistant Professor, "Removal-Cospectral Sets of Vertices in a Graph," 10th Southeastern Conference on Combinatorics, Graph Theory, and Computing, Boca Raton, Florida, 4 April 1979; and 82nd Summer Meeting of the American Mathematical Society, Providence, Rhode Island, 11 August 1978.

TURNER, John C., Assistant Professor, "Design of Multi Spectral Sensors," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 25 January 1979.

WARDLAW, William P., Assistant Professor, "Associativity in Finite Groupoids," 85th Annual Meeting of the American Mathematical Society, Biloxi, Mississippi, 24 January 1979.

WARDLAW, William P., Assistant Professor, "Generating Binary Operations," Regional Meeting of the Mathematical Association of America, Fairfax, Virginia, 21 April 1979.



OCEANOGRAPHY DEPARTMENT

Commander John G. McMillan, USN, Chairman



During the 1978-1979 academic year, faculty research was regularly undertaken by both civilian and military members of the Oceanography Department in a broad range of atmospheric and oceanographic sciences. Not only does this research provide the opportunity for the faculty to keep abreast of current technology, but it also serves as a basis for qualified midshipmen to undertake related research projects, particularly those relating to the Chesapeake Bay, where their work can be supported by the Departmental research vessel.

Funding for these research activities has been available from a number of sources, including grants from or contracts with the Iroquois Research Institute, National Oceanic and Atmospheric Administration, Department of Commerce, Naval Facilities Engineering Command, National Ocean Survey, Office of Naval Research, the Environmental Protection Agency, and the Naval Academy Research Council.

Specific areas of research activity by the Department include but were not limited to sedimentation processes and properties, submarine geology, oceanic eddy processes, estuarine pollution, estuarine ecology, marine optics, and oceanic circulation patterns.

GEOTHERMAL ENERGY RESOURCES OF NAVY/MARINE CORPS INSTALLATIONS ON THE ATLANTIC AND GULF COASTAL PLAIN

Researcher: Associate Professor Douglas W. Edsall

Sponsor: Naval Weapons Center, China Lake

The search for alternative energy sources is of great importance to the Navy. Preliminary examination of data from the literature, bottom hole temperatures from existing deep wells, and heat flow measurements in wells drilled at selected sites as part of a current research program sponsored by Department of Energy, have demonstrated that low temperature waters (<212°F) are available at moderate depths in the major sedimentary basins along the Atlantic and Eastern Gulf Coastal Plains. While the geothermal energy resources present here are not sufficient for electrical power generation, they appear adequate for space heating and cooling.

The radioactive decay of minerals in basement rocks and younger igneous intrusive bodies, primarily of granitic composition, is generating heat which is warming the waters of the overlying sedimentary blanket. While research at this time is still in the initial stages of resource evaluation, VPI-SU studies have delineated those areas most likely to contain geothermal energy resources. However, detailed geophysical work and further deep-drilling programs are needed to precisely locate exploitable geothermal resources available to the Navy.

The Navy should take a leading role in planning and executing exploratory drilling and resource evaluation programs, especially at its installations at Norfolk, Portsmouth, and Virginia Beach, Virginia; at Charleston, South Carolina; and at Pensacola, Milton, and Panama City, Florida--all of which are major energy users.

PROJECT SWIM (STUDIES OF WHALES IN ICELAND; THEIR MANAGEMENT)

Researcher: Assistant Professor John W. Foerster

Sponsor: National Oceanic and Atmospheric Administration

In reviewing data from the Denmark Straits, factors such as wind-stress and sea-surface temperatures are clues to hydrographic conditions in the whale feeding grounds. It is the researcher's conjecture that as an arctic frontal system passes, winds from the north drive cold arctic water into the warmer Irmiger Current, creating a mixing zone. During the early arctic summer these arctic waters are

fertilizing the slightly-warmer, more-saline, less-fertile Atlantic waters. However, it is hypothesized that the barriers to mixing created by density differentials are insignificant at this time and that the wind force is significant. Since day length is increasing in combination with this fertilization, production begins. As the front passes, the winds cycle to the south, pushing more warm water into the area so that mixing continues from these two gross compass locations.

A 12-minute, 16mm, sound and color film entitled "HVALUR" has been made on the whaling industry in Iceland.

EUROPEAN DREDGING: A REVIEW OF THE STATE OF THE ART

Researcher: Professor John F. Hoffman

Sponsor: Office of Naval Research Branch Office, London, and Naval Facilities Engineering Command

The U.S. Navy has the responsibility for the maintenance-dredging of the slips in which its ships are berthed. The investigation summarized below was made in order to determine the state-of-the-art of European dredging technology with a view towards improving slip maintenance by the U.S. Navy.

The European agencies or activities with which successful contact was made can be categorized as follows: dredging firms, dredging equipment manufacturers, port and river authorities, governmental departments (other than those included elsewhere), laboratories concerned with sedimentation and/or dredging in harbors, universities, and miscellaneous. Conferences were held with more than 40 people in Belgium, England, France, Germany, Holland, and Scotland. Inasmuch as the "miscellaneous" category does not appear directly in this report, the items included in it are as follows:

1. Attendance at the 16th International Conference on Coastal Engineering, Hamburg, Germany.
2. Attendance at NATO Conference on Long Term Scientific Study on Coastal Engineering, Sylt, Germany.
3. Visit with the Executive Secretary of the International Association of Dredging Companies, The Hague, Holland.
4. On-site review of the engineering works for the closure of the East Scheldt River, the last part of the Delta project, Zierickzee, Holland.

5. On-site review of the harbor expansion being undertaken at Zeebrugge, the second largest harbor in Belgium. This expansion, to be completed in 1982, is to enable tankers carrying LNG from Algeria to be berthed in the harbor. When completed the harbor will extend 2000 meters into the North Sea.
6. Attendance at the Eighth World Conference on Dredging, Amsterdam, Holland, and the Europort '78 Equipment Exhibition. At least one-third of the Exhibition was related to dredging equipment.

ONSHORE TRANSPORT OF OCEANIC POLLUTION RELATED TO NEARSHORE CIRCULAR CURRENTS ALONG THE EASTERN COAST OF THE UNITED STATES

Researcher: Professor John F. Hoffman

Sponsor: Naval Academy Research Council

Shoreline features along the coastlines of New Jersey and the Delmarva Peninsula indicate that nearshore currents flowing parallel to each of these coasts flow north in the northern portion of the barrier beach and south in the southern portion of the barrier beach. Inasmuch as the flow is a continuum, oceanic water must move westward toward the beach from some region offshore. It is conceivable that the movement of water may be in a closed circulatory pattern of unknown dimensions. In such a case, pollution at one part of a beach may move seaward and return to another part of the beach.

In support of this theory, the objective of this study was to examine maps for morphological features such as spits and the build-up of sand behind groins and jetties, to verify these features in the field, to assemble data on the offshore current velocities from the literature, to probe the findings of other agencies that may have assembled supportive information, and to examine aerial photographs and satellite imagery for pertinent features.

Field trips to examine beach features were made along the Atlantic Coast from Wilmington, North Carolina to Sandy Hook, New Jersey. Various technical publications were obtained and pertinent data extracted. The Coastal Engineering Research Center was visited to review their files and to discuss the problem with their personnel.

In summary, on the basis of information collected, the pattern of longshore current movement appears to be that for each barrier beach considered, a longshore current flows north along the northern portion of the same barrier beach and south along the southern portion of the same barrier beach. Water supplying these currents must be supplied by the westward movement of offshore oceanic water somewhere between the extremities of each barrier beach.

THE EFFECTS OF FOULING ON AN ACOUSTIC CURRENT METER

Researchers: Commander John P. Simpson, USN, and Commander Joseph J. Spigai, USN

Sponsor: Naval Academy Research Council

Mechanical ocean current-meters, such as the Savonius rotor and propeller type, have long been the standard instruments for measuring ocean current velocity for scientific and industrial purposes. A problem inherent in these devices is their susceptibility to the attachment of fouling organisms. Unprotected instruments, when left in a shallow-water, biologically-active, environment can foul to the stopping point in as little as a few weeks. Under such conditions, little long-term data can be obtained without frequent cleaning and/or re-application of antifouling material.

The inaccuracies of ocean-current data caused by fouling, along with numerous other problems resulting from immersion of mechanical devices under the sea, led to the development of current-meters with no moving parts. Two major designs of this type meter have emerged: the electromagnetic and, most recently, the acoustic current-meter. The electromagnetic current-meter (EMCM) operates on Faraday's law of electromagnetic induction and has enjoyed wide usage to date.

The other new design, the acoustic current-meter, is only now beginning to be produced by both U.S. and foreign manufacturers. The sensor to be tested operates on the travel-time-difference principle. It measures the fluid-flow magnitude and direction by sending short bursts of high frequency (4 MHz) ultrasonic waves in opposite directions between two combined transmitter/receiver transducers.

Although acoustic current-meters have been in commercial production for several years, there is little information relating the degree of fouling of specific acoustic sensors to reduction in accuracy. It is proposed to test an acoustic current-meter, to be provided on loan by the SIMRAD Corporation, in a shallow-water environment under a variety of fouling conditions--principally in the summer. Those factors which contribute to fouling and affect the accuracy of the current meter measurements will be examined in an effort to predict future performance.

TRANSPARENCY DATA ANALYSIS

Researcher: Professor Jerome Williams

Sponsor: National Oceanic and Atmospheric Administration

The objective of this project was to analyze transparency data in order that some determination could be made as to possible areas that seemed amenable to the use of a laser bathymetry system. A large data bank of the Chesapeake Bay area was investigated and condensed into station averages for each season. These were expressed as equivalent attenuation coefficients (α) converted from Secchi Disc readings and total suspended solid determinations. These seasonal station averages were then combined with station depths (D) and αD values were plotted and contoured on navigational charts for each season by means of modified NOS computer programs. These contours were then planimetered to determine areas of Chesapeake Bay having αD values below 20 (the limit of the present laser system). The net result was that over 80% of the Bay appears to be chartable using a laser bathymetry system. The project is now complete.

PREDICTING CULTURAL RESOURCES IN THE ST. FRANCIS RIVER BASIN - A RESEARCH DESIGN

Researcher: Associate Professor Douglas W. Edsall

The researcher was part of a team that arrayed all previous recorded archaeological, historical, and architectural resources in the 5,400,000 acres of the St. Francis river basin. Utilizing statistical formula, the team tested the accuracy of a predictive model which related cultural resources and physiographic variables. The researcher's primary involvement was in the establishment of a relationship between observable land forms and their patterns of utilization by successive groups of human inhabitants. Once this was done, it was possible to predict the age and density of sites in a region based upon an analysis of the land-forms present.



CLIMATOLOGICAL UPDATE OF ANNAPOLIS TEMPERATURES

Researcher: Midshipman 1/C Michael P. Butler

Adviser: Commander Richard A. Anawalt, USN

The last update of Annapolis climatology was performed in 1960. Since that time, the official observing station has been moved several times, and the data records are missing for some months. This project will recreate the missing data files through statistical comparisons of the Annapolis records with those of Baltimore since 1929. The annual temperature climatology will then be updated by adding the data from 1961-1978 to the data from 1931-1960.

LITERATURE SURVEY OF MARINE BIOFOULING OF OCEANOGRAPHIC INSTRUMENTATION

Researcher: Midshipman 1/C Gary Cerezo

Adviser: Commander Joseph J. Spigai, USN

The literature of marine biofouling is extensive. Although serious research in the subject pre-dates World War II, the major advances in our knowledge of the effects of biofouling on oceanographic instruments have come since 1970. A survey of U.S. and foreign journal and report literature since 1970 revealed over 300 classified and unclassified reports and journal articles pertinent to the subject. The major work in the U.S. has been done at Woods Hole Oceanographic Institution and the Naval Oceanographic Office, both of which have issued numerous reports on the effects of biofouling on moored current-meter arrays and other oceanographic sensors. England's National Institute of Oceanography has also produced numerous reports, particularly to the effects of fouling on shallow water sensors. Extensive work on fouling, and its prevention, is being carried on by scientists at the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory. Despite the number of studies available, only a very small percentage (less than 5%) go beyond descriptive work to report detailed quantitative results.

COMPARISON OF METHODS FOR COMPUTING THERMAL PLUMES

Researcher: Midshipman 3/C Dean E. Fish

Adviser: Professor John F. Hoffman

Many power plants and industries require the use of water from the Chesapeake Bay to cool processing equipment. After cooling, the heated water is returned to the bay. Once in the water the heated discharge assumes the configuration of a plume.

Wherever there are thermal plumes, there is concern about the diffusion of the heated water into the cooler water and heat transfer to the surrounding water and atmosphere. This paper defined the factors associated with thermal plumes in the Chesapeake Bay and examined the problems involved with thermal plumes.

Since the bay is a tidal estuary, tidal processes must also be considered. As the tide ebbs, tidal currents cause horizontal advection of the plumes in the direction of currents. As the tide floods, the resultant advection could very easily return the plume to near its original location. If there were several thermal discharges close together all influenced in like manner by the same tide, a hot pool could be formed.

REVIEW OF GRADUATE LEVEL COURSES IN GEOLOGY

Researcher: Midshipman 1/C Michael F. King

Adviser: Associate Professor Douglas W. Edsall

The purpose of this project was to study the geological sciences in preparation for the Advanced Graduate Record Examination in Geology. The topics which were covered included: Paleontology, Petrology Sedimentology, Regional Geology, Stratigraphy, and Structural Geology. The basic idea of the project was to give an in-depth overview of Geology from which, in addition to courses at the Naval Academy, (principally oceanography, physics and chemistry) the student could attempt to satisfactorily complete the Graduate Record Examination.

GEOTHERMAL ENERGY RESOURCES OF THE ANNAPOLIS AREA

Researcher: Midshipman 1/C Michael L. Mowins

Adviser: Associate Professor Douglas W. Edsall

This project reports on the potential for utilization of geothermal energy as an alternative energy source at the United States Naval Academy. The project also addresses the existing energy sources and utilization at the Naval Academy. The use of geothermal energy as an alternative energy source for heating, cooling, and electricity-generation is discussed.

DOCUMENTATION OF UNIVERSITY WEATHER FORECASTING COURSES

Researcher: Midshipman 1/C Randy J. Scanlon

Adviser: Commander Richard A. Anawalt, USN

Forty-eight colleges and universities which offer meteorologically-oriented curricula have been surveyed to document the various weather forecast games which are used throughout the country. From these 48 institutions, 41 responses were received, 25 of which included documentation of the forecast games being used. Results are now being tabulated and will be completed by mid-May 1979. Results of the survey are planned for publication later in the year.

ENERGY RESOURCES: WITH EMPHASIS ON GEOTHERMAL ENERGY AND ALTERNATIVE NAVAL APPLICATIONS

Researcher: Midshipman 1/C Stephen G. Squires

Adviser: Associate Professor Douglas W. Edsall

The initial goal of this project was to review four of the most obvious forms of energy alternatives and describe their potential for naval applications.

The first three investigations dealt with solar, wind, and tidal energy. The background of each was researched and the current state of the art described. Cost estimations were included for solar and wind energy. The fourth investigation concerned the origin and uses of geothermal energy. Also included is a short description of the economics involved for geothermal-energy production. Finally an assessment was made as to the development time of the resource as well as its feasibility at naval installations, such as that at Norfolk, Virginia.

ANALYSIS OF THERMAL EFFLUENTS

Researcher: Midshipman 1/C Alan M. Wiegel

Adviser: Assistant Professor John W. Foerster

The cooling water effluent from the Calvert Cliffs Nuclear Power Plant was analyzed to determine its suitability for use in a marine aquaculture system. Salinity, nutrient, and pH values were found to

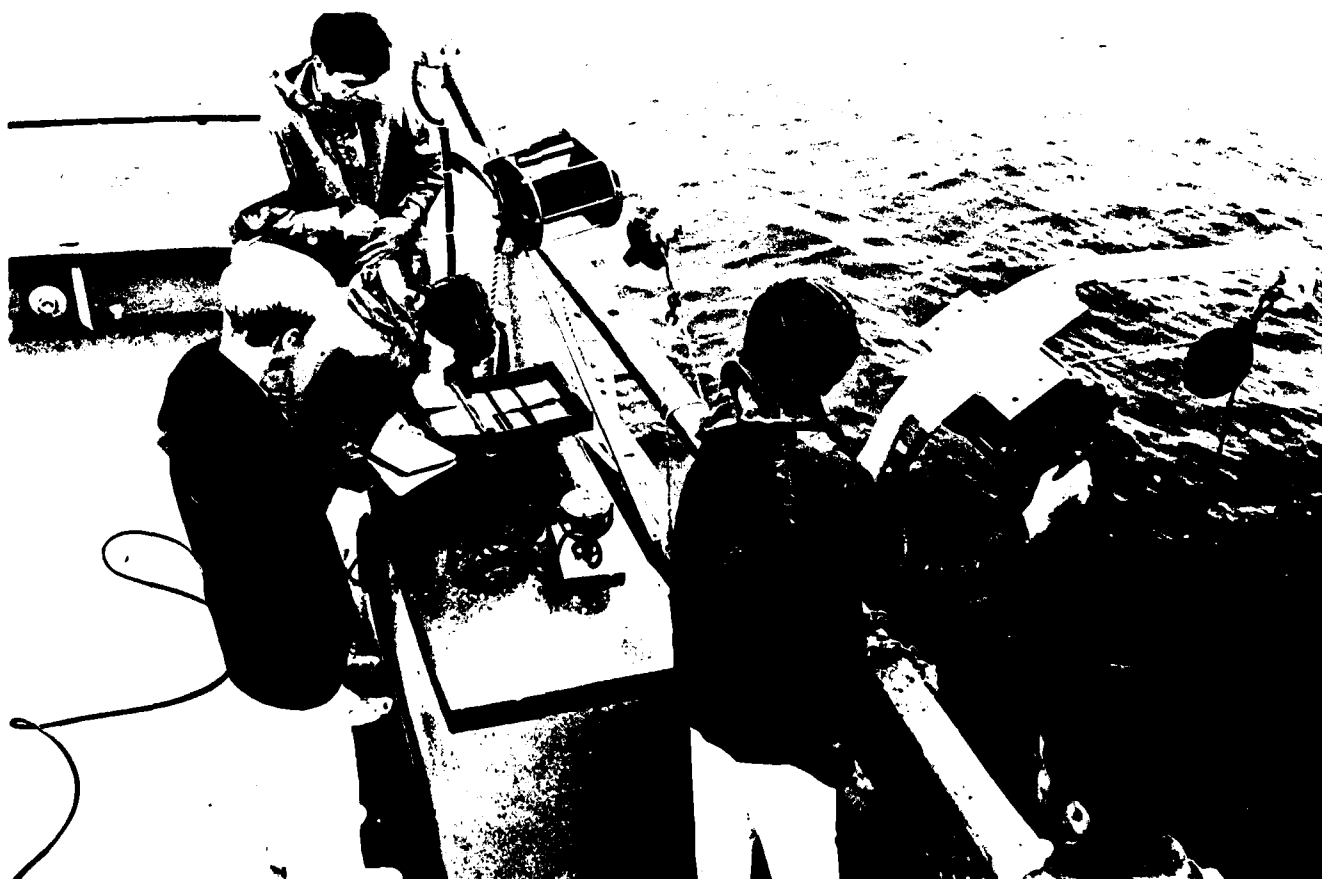
be similar to those in productive areas of Chesapeake Bay. The temperature at the sampling site was 10 degrees C. above ambient, and there was a 0.9 ppm Chlorine residual. The concentration of the heavy metals Al, Cr, Cu, and Fe were close to those found in Bay water; however, Zn concentrations were 8.5 times higher than normal.

INTERNAL WAVES AND THEIR APPLICATION TO OIL SPILL DISPERSAL

Researcher: Midshipman 1/C Jack V. Williams

Adviser: Professor Jerome Williams

This literature survey considers some of the more important papers that focus on internal waves in the eastern North Pacific. A total of six papers are summarized that discuss internal wave location, occurrence, characteristics, and anomalous behavior. Particular attention is devoted to the association of turbulence with internal waves.



EDSALL, Douglas W., Associate Professor, "Geothermal Energy Resources of Navy/Marine Corps Installations on the Atlantic and Gulf Coastal Plain," Technical Report, Naval Weapons Center, China Lake, California, September 1978.

The search for alternative energy sources is of great importance to the Navy. Preliminary examination of data from the literature, bottom-hole temperatures from existing deep wells, and heat flow measurements in wells drilled at selected sites as part of a current research program sponsored by Department of Energy, have demonstrated that low temperature waters (<212°F) are available at moderate depths in the major sedimentary basins along the Atlantic and Eastern Gulf Coastal Plains. While the geothermal-energy resources present here are not sufficient for electrical power generation, they appear adequate for space heating and cooling.

The radioactive decay of minerals in basement rocks and younger igneous intrusive bodies, primarily of granitic composition, is generating heat which is warming the waters of the overlying sedimentary blanket. While research at this time is still in the initial stages of resource-evaluation, VPI-SU studies have delineated those areas most likely to contain geothermal-energy resources. However, detailed geophysical work, as well as further deep-drilling programs, is needed to precisely locate exploitable geothermal resources available to the Navy.

The Navy should take a leading role in planning and executing exploratory drilling and resource-evaluation programs, especially at its installations at Norfolk, Portsmouth, and Virginia Beach, Virginia; Charleston, South Carolina; and Pensacola, Milton and Panama City, Florida--all of which are major energy users.

EDSALL, Douglas W., Associate Professor, co-author, "Predicting Cultural Resources in the St. Francis River Basin: A Research Design," prepared for the Memphis District U.S. Army Corps of Engineers, Iroquois Research Institute, September 1978.

The researcher was a part of a research team that arrayed all previous recorded archaeological, historical, and architectural resources in the 5,400,000 acres of the St. Francis river basin. Utilizing statistical formula, the team tested the accuracy of a predictive model that related cultural resources and physiographic variables. This researcher's primary involvement was the establishment of a relationship between observable land-forms and their patterns of utilization by successive groups of human inhabitants. Once this was done it was possible to predict the age and density of sites in a region based upon an analysis of the land-forms present.

FOERSTER, John W., Assistant Professor, "Evidence for a Resident Alewife Population in the Northern Chesapeake Bay," Estuarine and Coastal Marine Science, 7 (1978), 437-444.

Data developed from field sampling for age and growth, histology, and behavior patterns indicate the existence of a 'resident' alewife population in the northern Chesapeake Bay. Growth appeared faster and sexual maturation is two years earlier than for larger anadromous forms. Scale analyses reveal no evidence of migration to and from salt water. It is hypothesized that a race of alewives meristically similar to the mean anadromous population but different in growth rate, sexual maturation, fecundity, and spawning period, is developing in the northern Chesapeake Bay.

FOERSTER, John W., Assistant Professor, "Sargasso Sea Expedition," Explorer's Journal, 6 (1978), 181-184.

The Sargasso Sea is reputed to be an area of low biological activity. Presumably isolated from surrounding waters because of physical characteristics, the area has been defined by oceanographers as a biological desert. However, deserts have active areas of production.

In an effort to determine if the Sargasso Sea has active biological regions, a study was performed to test the hypothesis that spatial heterogeneity existed. Photoplankton data were developed from sampling two parallel cruise tracks running northwest to southeast across the Sargasso Sea. The algal relationships are emphasized at this time though zooplankton and physical oceanographic forces are under study.

HOFFMAN, John F., Professor, "European Dredging--A Review of the State of the Art," Office of Naval Research Branch Office, London, R-12-78, November 1978.

The state of the art of dredging in Europe is described. The details resulted from a three-month on-site investigation in the countries of Belgium, England, France, Germany, Holland and Scotland. Information was obtained during conferences involving more than 40 persons. Visited were two dredging firms, one manufacturer of dredging equipment, three universities, six laboratories concerned with the hydraulics and/or sedimentation in harbors, eight port authorities, and three miscellaneous federal agencies. New dredging technology (modifications to old dredging technology) and dredging practices in selected European ports are discussed. The facilities and capabilities of the hydraulic laboratories visited are described.

FOERSTER, John W., Assistant Professor, "Midshipman Probe Bay," Campus (1978), 10-14.

This article is a presentation of OPERATION INTEREST (Integrated Training Experience Related to Estuaries) and depicts use of YP654 for oceanographic work. It is a program conceived by Midshipman 1/C Alan Wiegel to expand out-of-classroom learning experience in the Oceanography Department. INTEREST is to become part of the Department's curriculum as a non-graded training opportunity for midshipmen willing to participate during their leave time at the end of the Spring Semester.

The program utilizes the 71-ton Yard Patrol Craft which is oceanographically equipped to research pollution prevention, beach erosion containment, biofouling elimination and amphibious warfare. All the problems of the coastal environment can be found in the Chesapeake Bay, and Operation Interest is designed to display the tools of the trade to interested midshipment and to gather useful information on the dynamics of the bay.

WILLIAMS, Jerome, Professor, Introduction to Marine Pollution Control, New York: Wiley-Interscience, 1979.

A holistic approach to coping with marine pollution, this introductory resource discusses physical, chemical, biological, legal, and sociological considerations in unusually realistic and precise terms. The emphasis throughout is on frequently encountered problems and situations, including the political limitations of technology and the critical need for improved marine management throughout the world.

Beginning with a description of ocean characteristics, the author provides insights into the nature of pollution, the origin of marine pollutants, and both acute and chronic effects.

Major techniques for controlling marine pollution are covered in depth, including dispersion, storage, recycling, reclamation, zoning, and taxation. Full explanations are presented of the forces involved in dispersing pollutants, and the advection process. The diffusion and other predictive models are illustrated and analyzed.

Concise, easy-to-grasp descriptions of the interactions of the hydrosphere, atmosphere, lithosphere, and biosphere help clarify major pollution issues.

The book concludes with a far-reaching look at both current management practices and the future of the marine environment.

PRESENTATIONS

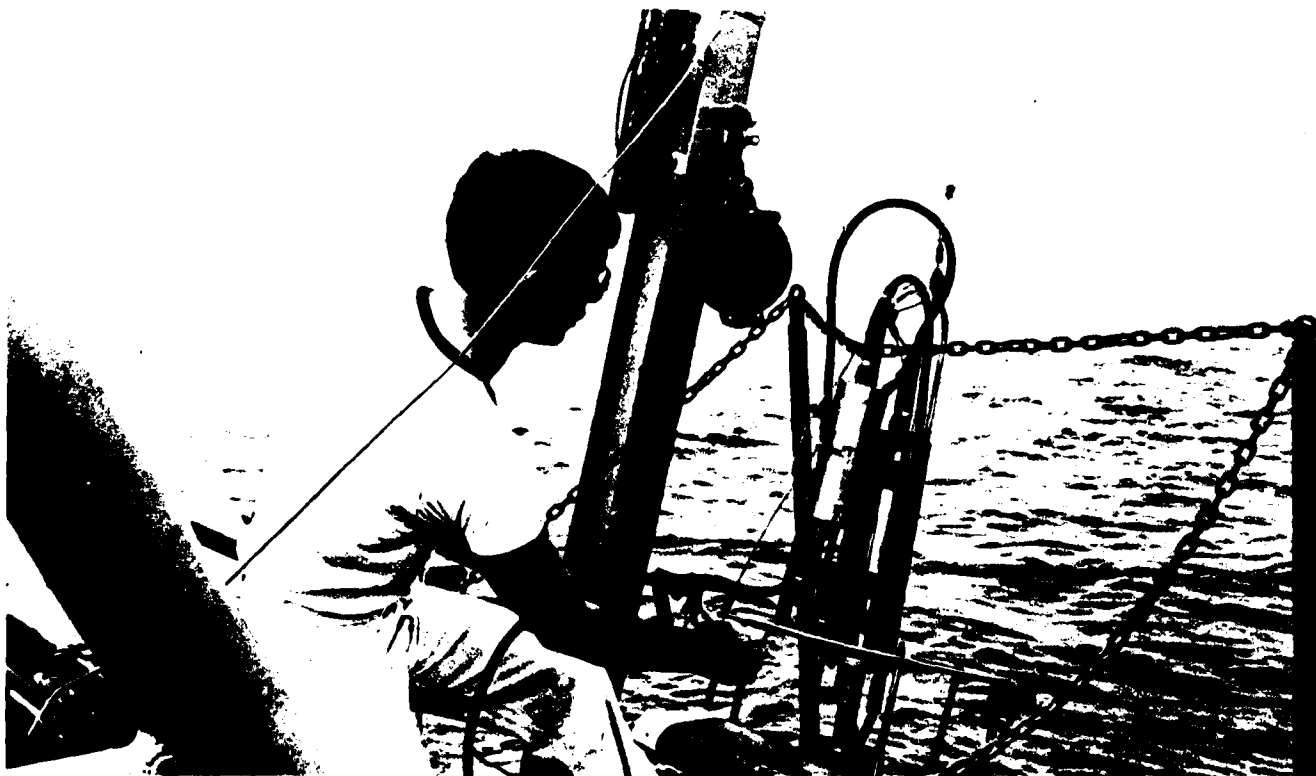
OCEANOGRAPHY DEPARTMENT

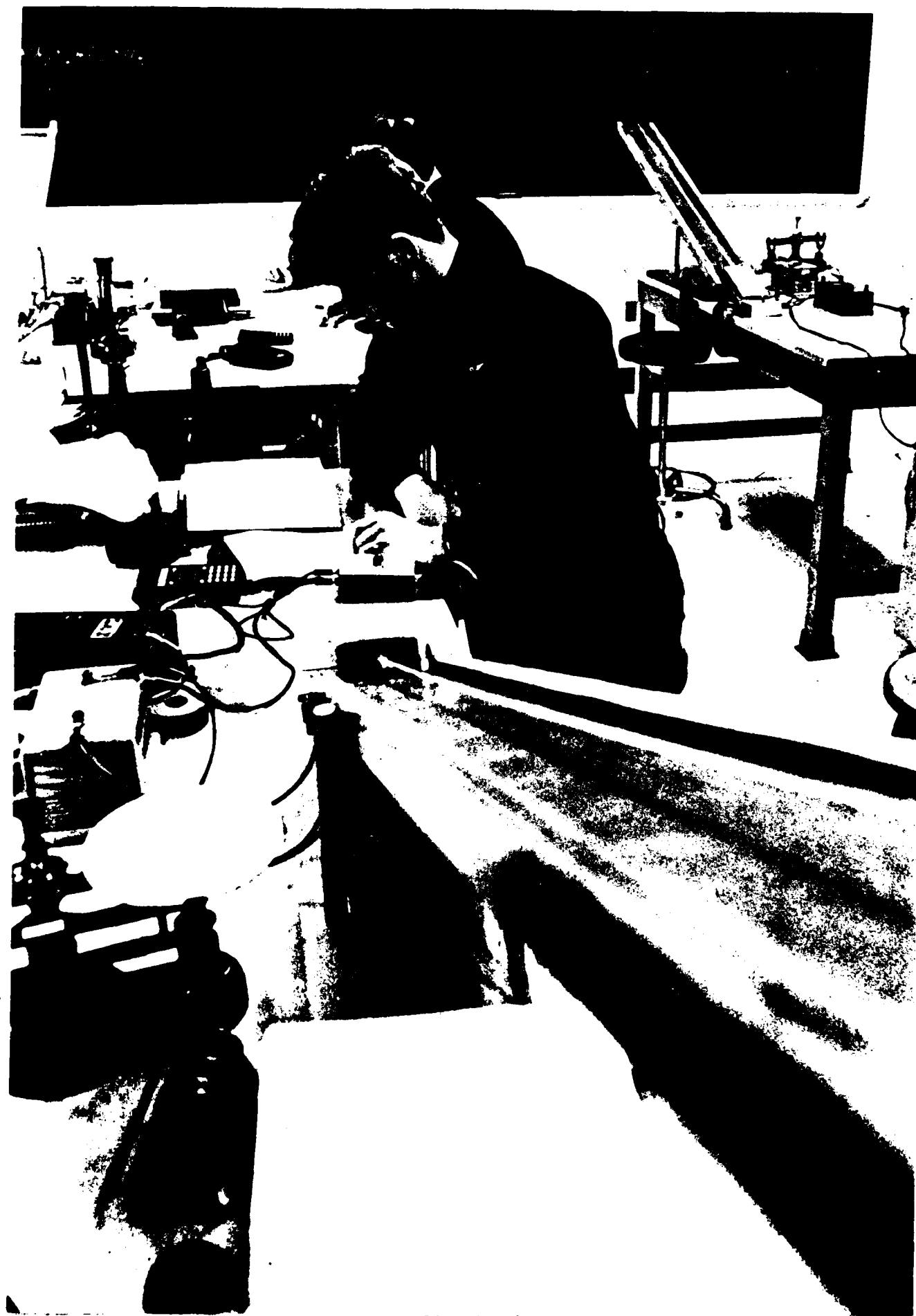
FOERSTER, John W., Assistant Professor, "Phytoplankton Activity Across the Sargasso Sea," 18th Northeast Algal Symposium, Marine Biological Laboratory, Woods Hole, Massachusetts, 27-28 April 1979.

FOERSTER, John W., Assistant Professor, "Whaling," Oceanography Club, U. S. Naval Academy, Annapolis, 4 May 1979 and Marine Mammals Program, National Oceanic and Atmospheric Administration, Washington, D.C., 27 May 1979.

WILLIAMS, Jerome, Professor, "Using Latex Spheres as an Artificial Turbidity Agent," October meeting of Atlantic Estuarine Research Society, Easton, Maryland, 6 October 1978.

WILLIAMS, Jerome, Professor, "A Predictive Model for the Transparency of Estuarine Waters," Wetlands and Estuarine Processes Workshop, New Orleans, Louisiana, 19 June 1979.





PHYSICS DEPARTMENT

Professor Gerald P. Calame, Chairman



The research effort in the Physics Department reflects the wide range of expertise in the Department's faculty. Present activities cover research in the following areas: Acoustics, Astronomy, Computer-Assisted Education, Electric and Magnetic Properties of Materials, Fiber Optics, High-Resolution Spectroscopy, Magnetic Signatures of Ships, Radiation Effects in Solids, Solar-Energy Applications, Special Relativity, and Theoretical Mechanics. In many instances, midshipmen are actively engaged in the research, either as Trident Scholars or through accredited research courses.

RESONANCE THEORY OF ELASTIC SHEAR-WAVE SCATTERING FROM SPHERICAL-FLUID OBSTACLES IN SOLIDS

Researcher: Associate Professor Donald W. Brill

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

The vector potential for an arbitrarily polarized shear-wave in an elastic (lossless) medium incident on, and scattered by, a spherical fluid occlusion is expanded in a series of vector spherical harmonics. The boundary conditions are dealt with in terms of two scalar Debye shear-potentials which are referred to as "s and t waves." The s-wave scatters into another s wave and also mode converts into a compressional p-wave. The t-wave scatters only into another t-wave. Scattering amplitudes are cast in a series of resonance terms. The scattered s and p waves exhibit resonances; however, the t-waves do not. Bistatic plots of the first few partial wave amplitudes are made for the sp, ss, and tt scattering modes. When the background amplitude for the scattering from an evacuated spherical cavity is removed from each partial wave-contribution, the remaining portion of the amplitudes is clearly a series of liquid-sphere resonances.

INVESTIGATION OF TONE-GENERATION BY FLOW OVER WALL-MOUNTED CAVITIES

Researcher: Professor Samuel A. Elder

Sponsor: General Hydromechanics Research Program
Naval Sea Systems Command, administered by David W. Taylor
Naval Ship Research and Development Center

The purpose of the project is to develop a theoretical model of tone-generation by flow over wall cavities, applicable to the control or elimination of cavity tone-effects in ship design. During the initial year of this two-year study, an experimental investigation is being made of the development of a separated shear-layer in the immediate vicinity of the leading edge of a wall-mounted cavity. The fundamental problem to be solved is the dynamic response of a driven separated shear-layer, and its relation to upstream flow-structure and cavity geometry. Of particular importance is to establish the appropriate boundary condition governing the traveling shear-layer wave solutions. Since trailing edge feedback is believed to be more common than acoustic cavity feedback in underwater situations, a feedback model of cavity oscillation, based on trailing edge influence, has been developed. Tests continue on the general validity of the model, using air-tunnel simulations. In order to demonstrate the ultimate applicability of the results to underwater problems, further tests are being designed to be performed in the Navy's KAMLOOPS facility in Idaho.

MODELING MAGNETIC FIELD SOURCES

Researcher: Associate Professor William E. Fasnacht

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

The magnetic field of a ship may be characterized by the magnetic scalar potential, which in turn may be expanded in a series of prolate spherical harmonics. D. A. Nixon of DWTNSRDC has shown that such an expansion is appropriate, has done extensive calculations determining the coefficients of such an expansion from measured values of the magnetic field, and has developed some preliminary explanations of the physical significance of various terms.

The work of this researcher in the last year has concentrated upon two areas: the interaction between the available measurements and the complexity of the mathematical model which can be supported by those measurements; and alternative physical interpretations of the significance of various coefficients. A general way of determining what mathematical model can be supported by a particular set of physical measurements was developed. A tentative physical model in which all effects are attributed to a surface density of monopoles was proposed. This, in effect, allows the magnetization to have no divergence except at the surface of the source. All models of the distribution calculated with this model agree with those determined otherwise. The work is continuing.

RADIATION EFFECTS IN FIBER OPTIC MATERIALS

Researcher: Associate Professor John J. Fontanella

Sponsor: Naval Research Laboratory

The primary purpose is to perform optical and dielectric absorption and electron-spin resonance measurements on various samples of fused silica in order to further characterize and properly identify the radiation-sensitive defect center found dielectrically during the past year. Specifically, it is felt that the observed relaxation is due to an aluminum-alkali center, and an attempt will be made to correlate the dielectric signal to the well-known aluminum-associated electron spin resonance spectrum. The correlation will be attempted by varying radiation dose and carrying out isochronal annealing studies. In addition, studies of the effect of radiation on the low temperature hydroxyl associated relaxation may be carried out. Finally, a wide selection of silicate glasses may be studied dielectrically.

TRANSMISSION LOSS IN OPTICAL FIBERS DUE TO NEUTRON IRRADIATION

Researcher: Associate Professor Richard L. Johnston

Sponsor: Naval Research Laboratory (NRL)

The use of optical fibers in the communication industry is proceeding faster than expected, and numerous systems have been installed throughout the world.

The Navy is particularly interested in fiber optics because of the small size, light weight and electromagnetic immunity as compared to wire and cable communication systems. However, there is the necessity of determining what the response of the fibers is to ionizing and non-ionizing radiation if they are to be used near reactors or are able to function near a nuclear explosion.

Optical fibers provided by the Optical Materials Branch, NRL, were bombarded with 14.7 MeV neutrons using the neutron generator of the Naval Systems Engineering Department of USNA.

About 18 meters of the fiber wound on a 1 1/4 inch diameter coil was placed 1/2 inch from the source of neutrons. Through the fiber was transmitted 820-nm light and the amount of light detected was measured during the irradiation so that changes in the transmission could be observed. The recovery was also followed after the irradiation to determine if there was any recovery, and if so, then the rate at which it recovered.

The transmission spectrum from 500- to 1700-nm was measured before and after the irradiations to determine the wavelength characteristics of the radiation produced loss.

The radiation-induced losses varied from 28- to 250-db/km/10¹¹ neutrons, varying with the composition and manufacturing process. The absorption was in 2 broad bands at 700-nm and 1400-nm independent of the type of fiber.

The project is continuing in order to seek out radiation-resistant fibers that are suitable for naval systems.

COMPUTER TUTORIALS IN BASIC MECHANICS (INSTRUCTIONAL DEVELOPMENT PROJECT)

Researcher: Associate Professor Bruce H. Morgan

Sponsor: Naval Academy (Academic Dean)

Interactive computer graphics will be employed to help students learn how to translate real-world problems into a conceptual form to which physical laws can be applied. Specifically, the objective is to help students master the conceptual framework which underlies and builds upon the free body diagram of basic mechanics.

Persual of literature on instructional design has led to a systematic method of programming each tutorial session: (1) selection of topic and problem; (2) task analysis, generating a learning hierarchy of performance objectives; and (3) generation of an instructional sequence in the form of a flow chart, which is then the basis of the computer program.

The first tutorial session on vector resolution is ready for evaluation. Work has begun on a tutorial in a rigid-body equilibrium. A third one will deal with accelerated motion in one dimension. Each will be implemented on USNA's Tektronix computer terminals.

DAMPING ASSOCIATED WITH OSCILLATING BUBBLES

Researcher: Associate Professor David A. Nordling

Sponsor: Naval Academy Research Council

The objective of this project is to measure the damping of a bubble suspended in a liquid by an acoustic field.

The plan of investigation is to compare the phase-difference between the driving signal and that associated with the oscillating bubble.

A photomultiplier detector is used to detect light scattered from an oscillating bubble so that this signal could be compared, in terms of phase, to that of the original driving frequency.

For the bubbles observed, the theoretical phase difference was of the order of 5° - 10° . Because of low levels of the signal detected, the uncertainty in the measurements was about as large as that which was to be measured. Therefore, conclusive results were not completely achieved.

During the course of the experiment, a technique was developed for the measurement of the mean radius of the bubble under investigation.

MAGNETOELESTICITY OF ULTRASERVICE STEELS

Researcher: Associate Professor Carl S. Schneider

Sponsor: David W. Taylor Naval Ship Research and Development Center,
Annapolis Laboratory

The objectives of this project are to determine experimentally the response of the induced and remanent magnetization to changes in applied field, strain, vibration, and temperature.

Using Helmholtz coils to cancel the Earth's magnetic field within 0.2 per cent, an end-compensated solenoid applies a known field to various samples which may simultaneously be subjected to vibration, tension, compression, and temperature changes. The magnetization change is detected using an induction coil and integrator circuit as well as with a fluxgate DC magnetometer to sense remanence.

The strain, magnetic field, temperature, and remanence coefficients of permeability have been determined for HY80, HY100 and HY130 rods as well as toroids showing no anisotropy with roll direction but pronounced size (machining strain) effect. Measurements on vibration coefficients of permeability as well as the strain, field, temperature, and vibration effects on remanence are underway.

DEFECT STATES IN III-V SEMICONDUCTORS

Researcher: Associate Professor Robert N. Shelby

Sponsor: Naval Research Laboratory

The purpose of this research is to characterize defects in III-V semiconductions. The emphasis will be on defect-states produced by impurities introduced during fabrication of junctions and defect-states induced by radiation damage caused during ion implantation.

The current procedure is to use deep-level transient spectroscopy (DLTS) to determine the energy, capture cross section, and concentration of the trapping or defect-states. Results on states in GaAs have been reported and current work is concentrated on GaP and GaAsP.

THE KINETICS OF ION MOTION IN $\text{CaF}_2\text{:Er}$

Researcher: Midshipman 1/C David A. Beam

Adviser: Associate Professor Donald J. Treacy

Sponsor: Trident Scholar Program

The kinetics of ion motion in $\text{CaF}_2\text{:Er}$ were investigated by looking at the equilibrium configuration after the crystals had been quenched from high (700°C) temperatures. The spectral region of the Er E manifold was investigated spectroscopically. Changes in the absorption spectra were monitored as functions of the temperature of the crystal immediately prior to quenching. The equilibrium between the various defect configurations was modeled as being caused by mobile fluorine ions at elevated temperatures.

The work raised interesting new questions which will be investigated.

DIPOLAR DEFECTS IN RARE-EARTH DOPED ALKALINE EARTH FLUORIDES

Researcher: Midshipman 1/C Michael K. Smith

Adviser: Associate Professor John J. Fontanella

Sponsor: Trident Scholar Program

Audio frequency dielectric relaxation measurements from 5.5-380K and ionic thermocurrent measurements from 90-290K have been used to study the relaxation of dipolar defects in several calcium fluoride samples doped with two rare-earths. Four of the five strong relaxations that occur in rare-earth doped calcium fluoride were studied. A fit of the dielectric relaxation data for the R_I relaxation region reveals that the R_I relaxation is associated with a simple-point defect. This site is assigned to the reorientation of a nearest neighbor interstitial fluorine ion around a single rare-earth. The R_{II} relaxation is also shown to be associated with a simple-point defect. New relaxations are observed in the R_{II} region in doubly doped samples and are assigned to the stabilization of R_{II} sites for rare-earths that do not form this site in singly doped crystals. Activation energies for these relaxations are 0.170 eV. for samarium and 0.182 eV. for praseodymium. New relaxations are observed in the R_{III} and R_{IV} regions. These new relaxations are assigned to hybrid cluster-sites within the samples. On the basis of previous optical, concentration dependence, and thermal studies the R_{III} relaxation is associated with a site containing three rare-earths, a trimer. Since only one new relaxation is observed in the R_{IV} region this relaxation is assigned to a site containing two rare-earths, a dimer.

COUPLED-OSCILLATOR TREATMENT OF THE FOUCAULT PENDULUM

Researcher: Professor Gerald P. Calame

The problem of the Foucault Pendulum is a standard one in classical mechanics. The usual methods of solution, however, tend to lose the physical content of the problem in a maze of mathematical detail. This difficulty has now been overcome by treating the problem as that of basic oscillations in the North-South and East-West directions that are coupled by the coriolis force. Use of a slight but obvious modification of the standard procedures for solving coupled-oscillator problems then yields the normal modes for the pendulum. Superposition of the modes then results, in a very transparent way, in the standard expression for the angular frequency of rotation of the plane of oscillation of the pendulum as a function of latitude.

GENERALIZED DOPPLER EFFECT IN SPECIAL RELATIVITY

Researcher: Professor Gerald P. Calame

The usual discussion of the Doppler effect in the theory of special relativity is restricted to the observation of electromagnetic waves in a vacuum. This problem is particularly simple because no distinction can be made between motions of the source and the observer in such a case. An attempt to generalize the result to the propagation of arbitrary waves in a medium other than empty space is in progress. The problem is being approached by writing the expression for the waves as seen by an observer moving with the source and then performing two successive Lorentz transformations: the first from the source to an observer stationary in the medium, the second from the medium observer to a moving observer. The problem has been solved for the cases in which the source and the observer move directly towards each other through the medium, and for the case in which the source is stationary but the observer moves obliquely with respect to it. The case in which the source is moving arbitrarily is under study.

DEVELOPMENT AND DOCUMENTATION OF A DATA BASE QUALITY CONTROL PROGRAM

Researcher: Lieutenant Commander Martha S. Lyon, USN

In the eight-year period since the establishment of the Naval Ocean Surveillance Information Center (NOSIC), data manipulation has been dependent upon the quality of initial word-of-mouth instruction and subject to a wide latitude of individual analyst variation. To improve the quality of information produced by the NOSIC, documentation of procedures and development of data base quality-control practices were necessary.

The initial task required the definition and standardization of data handling procedures which required no analytic judgments. Next, general queuing patterns for handling common but not routine data requiring analyst decisions were identified. Definition of these processes indicated the need for establishing practices which would conserve valuable analyst-time while producing quality data required to support customer requirements.

Evolving from the first task was the requirement to document the data-manipulation practices. It was desired that the resulting document would serve as a training manual for new analysts and as a reference source for other analysts, thereby meeting one requirement of the desired quality control program.

Present tasking is to accomplish documentation of computer programs associated with systems interfaces. This work will be pursued during the summer of 1979.

Based on experience with the present computer system, this officer is an ad hoc member of an inter-community committee which was formed to plan for a systems-update based on projected requirements.



ELECTRICAL PROPERTIES OF BISMUTH GERMANATE

Researcher: Midshipman 1/C Daniel W. Bursch

Adviser: Associate Professor John J. Fontanella

The audio frequency complex dielectric constant has been measured at room temperature for various samples of bismuth germanate. It is found that two distinct types of materials exist, depending on the stoichiometry. One type has a characteristic dielectric constant of 15.6 while the other is about 50. Their former material is of technological interest since the dielectric constant is about a factor of 4 greater than pure fused silica while the resistance is about the same (extremely high). Preparations are being made to measure both the pressure and temperature variation of the dielectric properties.

PHOTOELECTRIC PHOTOMETRY OF GO CYGNUS

Researchers: Midshipmen 1/C Phillip Cullom and John Pross

Adviser: Professor Graham D. Gutsche

A photometric study of the fast eclipsing binary system GO Cygnus was undertaken, using the USNA 16-inch reflecting telescope equipped with a Johnson-type photometer. Measurements were made in the three colors, U, B and V. Because of instrumental difficulties and atmospheric conditions, definitive results were not obtained, but data is consistent with a previous study of this system.

Additionally, a complete documentation of a completely computerized analysis of the light curve to obtain the ephemeris and orbital elements was prepared.

SPECTRAL INVESTIGATIONS OF $\text{CaF}_2:\text{Er}$

Researchers: Midshipmen 1/C William R. Hayes and Michael Muldoon

Adviser: Associate Professor Donald J. Treacy

High resolution spectroscopy is frequently necessary to resolve narrow spectral bands. A high-resolution Jarrell-Ash 2m spectrograph was used to clarify the spectral shape of Er^{3+} absorptions in a CaF_2 matrix. The motivating force behind this project is to determine the spectral line widths to compare to those taken at lower resolution to obtain a quantitative estimate of the number of defect centers actually causing the absorption. The work is still in progress.

RESEARCH COURSE PROJECTS

PHYSICS DEPARTMENT

ISOCHRONAL ANNEALING STUDIES OF GAMMA-IRRADIATED FUSED SILICA

Researcher: Midshipman 1/C Gregory S. Parker

Adviser: Associate Professor John J. Fontanella

A furnace, chamber, and sample-holder has been assembled for performing annealing studies from room temperature to 1000°C. The furnace has been calibrated using chromel-alumel thermocouples. A preliminary run was made on gamma-irradiated fused silica. The sample was studied before thermal treatment using dielectric and optical absorption and electron-spin resonance techniques. The same experiments were performed on the sample after an anneal at 110°C for 15 minutes. Very little effect was seen, indicating that higher temperatures will be necessary to reverse the radiation effects.

STUDY OF UNDERWATER ACOUSTICAL PROPERTIES OF THE CHESAPEAKE BAY

Researcher: Midshipman 1/C Richard D. Peck

Adviser: Professor Samuel A. Elder

An experimental study of the acoustical properties of the Chesapeake Bay was performed, making use of the Naval Academy's oceanographic vessel. Salinity, temperature, depth, and sound velocity were measured at 15 locations, with readings being taken at 2-meter depth intervals. Sound velocities determined by computer program were compared with measured values, with error being recorded as a function of salinity, temperature, and depth. In a related study, a survey was made of the underwater ambient noise conditions near the Naval Academy seawall. An underwater transducer calibration was performed in the Acoustics Laboratory indoor tank facility, using a standard J-9 projector.

ACOUSTIC SIGNATURES OF AMERICAN RATTLESNAKES

Researcher: Midshipman 2/C Patrick Troy

Adviser: Professor Samuel A. Elder

The purpose of the project was to investigate the acoustic signature of the noise emissions by rattlesnakes, with a view toward developing an acoustic method of species discrimination. A local snake hobbyist volunteered to furnish live snakes, and measurements were made of noise emissions for several species, using equipment in the Acoustics Laboratory of Michelson Hall. In addition to the live snake measurements,

a study was made of the dynamic properties of detached rattles, using a computer-sampling technique. Originally it has been planned to develop a theoretical model of the sound-producing mechanism. However, the semester ended before this aspect of the problem could be completed.

ELECTRICAL RELAXATION STUDIES IN RARE-EARTH DOPED BARIUM FLUORIDE

Researcher: Midshipman 1/C John Wolfe

Adviser: Assistant Professor Mary C. Wintersgill

A complete set of rare-earth doped barium fluorides, except the sample doped with erbium which has been prepared previously, as well as samples of barium fluoride doped with Lanthanum and Yttrium, have been ground, polished, and prepared for dielectric measurements. These measurements will give a comprehensive picture of the properties of doped barium fluoride, allowing comparison of the effects of different dopant ion size as well as comparison with other alkaline earth fluorides doped with the same rare earth ions.



BEAM, David A., Midshipman 1/C, Donald J. TREACY, Associate Professor, and John J. FONTANELLA, Associate Professor, "Changes in Charge Compensation Configurations in $\text{CaF}_2:\text{Er}(3+)$ When Quenched," Bulletin of the American Physical Society, 24 (1979), 376.

The spectral region of the $E(^4S_{3/2})$ manifold of Er^{3+} in CaF_2 has been studied as a function of the temperature of quench of the crystal in the temperature region of 500 to 1125K. A shift of the absorption strength among at least five spectral bands has been observed. These processes may be characterized as an Arrhenius with two distinct activation energies of $E_{a1} \sim 0.5\text{eV}$ and $E_{a2} \sim 1.0\text{eV}$. This is significant for it suggests that one mechanism is not responsible for the equilibrium among the various types of defect (charge compensation schemes) found in $\text{CaF}_2:\text{Er}^{3+}$.

The population of the various defect-centers has been correlated with dielectric relaxation and laser spectroscopy work in an attempt to establish models for the various charge compensation schemes.

BEAM, David A., Midshipman 1/C, "The Kinetics of Ion Motion in $\text{CaF}_2:\text{Er}$," Trident Scholar Project Report Number 97, Nimitz Library, U. S. Naval Academy, Annapolis.

The kinetics of ion motion in $\text{CaF}_2:\text{Er}$ were investigated by looking at the equilibrium configuration after the crystals had been quenched from high (700°C) temperatures. The spectral region of the Er E manifold was investigated spectroscopically. Changes in the absorption spectra were monitored as functions of the temperature of the crystal immediately prior to quenching. The equilibrium between the various defect configurations was modeled as being caused by mobile fluorine ions at elevated temperatures.

The work raised interesting new questions which will be investigated.

ELDER, Samuel A., Professor, "Application of Root-Locus Method to Cavity Resonance," Journal of the Acoustical Society of America, 64 (S1) (1978) S84(A).

A root-locus solution for the frequency lock-in problem has been obtained for a wall-mounted cavity in turbulent flow, oscillating at Helmholtz or depth-mode resonance. For case where acoustic wavelength is large compared to cavity-mouth dimension, feedback takes the form of a simple transverse modulation by acoustic standing-wave in the cavity.

System gain is found to derive from periodic deflection of volume flow into the cavity from external fluid as in Type-I organ pipe oscillation. Unlike the organ pipe case, however, only downstream interface waves are observed, there being no boundary condition imposed on the slope of the interface at leading edge. Phase velocity of the interface wave is obtained from mean-stream velocity profile, using linearized instability theory. The system is capable of oscillation at frequencies both above and below resonance, the exact resonant condition being characterized by a streamwise slot width ($M-1/4$) times the interface wavelength, where M is an interger. From a knowledge of the nonlinear orifice-resistance characteristic, oscillation amplitude can be predicted as a function of slot-width.

ELDER, Samuel A., Professor, "Edgetones vs. Pipetones," Journal of the Acoustical Society of America, 64 (1978), 1721 (L).

It is here argued that the commonly-held view of organ pipe oscillation as pipe-controlled "edgetone" oscillation is misleading. Edge-related effects, being of higher multipole order than the pipe-related air motion, are inherently less efficient, and may be ignored in the presence of strong resonator coupling. It is proposed that the term edgetone or "jet-edge oscillation" be applied to a free jet-edge (or weakly-coupled pipe) situation, while a normal resonant organ pipe oscillation should be referred to as "pipetone."

ELDER, Samuel A., Professor, "Self-Excited Depth-Mode Resonance for a Wall-Mounted Cavity in Turbulent Flow," Journal of the Acoustical Society of America, 64 (1978), 877.

Experimental and theoretical results are presented for a wall-mounted cavity in turbulent flow, oscillating at Helmholtz or depth-mode resonance, where the mouth dimensions are small compared with acoustic wavelength. A new, computerized, hot-wire method was employed to investigate the oscillating flow-field in the cavity mouth. Measured wavelength of the interface wave agrees well with predictions of Michalke, using an equivalent laminar flow-model based on the oscillating mean velocity profile. By means of a forward-transfer function derived from the theoretical interface wave-model and a backward transfer function derived from organ-pipe theory, a root locus solution of the frequency lock-in problem has been obtained. Predicted frequencies and sound-pressure amplitudes are in good agreement with experimental values at the lower modes. Both resonant and off-resonant

oscillation was investigated. For resonant oscillation, the streamwise slot width is required to be $M - 1/4$ times the disturbance wavelength, where M is an integer. For situations in which the equations are applicable, the method can be used to predict design parameters for non-oscillating wall cavities in moving vessels.

FONTANELLA, John J., Associate Professor, Mary C. WINTERSGILL, Assistant Professor, and Richard L. JOHNSTON, Associate Professor, "The Dielectric Properties of As-Received and Gamma Irradiated Fused Silica," Bulletin of the American Physical Society, 24 (1979), 94.

Audio frequency capacitance and conductance measurements have been carried out on 15 kinds of fused silica over the temperature range 5.5-380K. The results are used to arrive at corresponding values for the complex dielectric constant. It is shown that the relative strengths of the three relaxations observed in as-received fused silica are characteristic of the Type of fused silica. In addition, it is found that one of the relaxations can be destroyed by gamma rays and that the destruction is accompanied by the creation of a lower activation energy relaxation. A corresponding growth of 440- and 630-nm optical absorption bands is observed. The gamma ray sensitive relaxation is attributed to an aluminum-alkali center and the gamma ray induced relaxation is attributed either to an aluminum-oxygen-hole center or to a "nonlocal" alkali ion. Results of isochronal annealing studies are also presented.

FONTANELLA, John J., Associate Professor, and David L. JONES, Ensign, USN, "Dipolar Complexes in Rare-Earth Doped Strontium Fluoride," Physical Review, 18 (1978), 4454-4461.

The complex dielectric constant has been measured at five audio frequencies over the temperature range 5.5-390K for various concentrations of Ce, Eu, Gd, and Eu in SrF_2 . Three principal relaxations are observed, two of which have been studied by previous workers. The shift in relative population between the two peaks with ion size, observed previously, has been verified and the ratio of the dipole moments is found to be approximately 2.8 consistent with the identification of the two relaxations as Type I and Type II dipoles. In addition, under the assumption of thermal equilibrium, enthalpy differences for the two species in $\text{SrF}_2:\text{Gd}$ and $\text{SrF}_2:\text{Eu}$ are found to be 0.049 eV and 0.078 eV, respectively, which is also consistent with the previous identifications. However, no firm evidence for thermal equilibrium between the two dipoles is obtained. The third relaxation is a low-activation energy process

which occurs for large concentrations (>0.1 mol-%) of small rare-earth ions. Consequently, it is concluded that the new relaxation is cluster-associated. A similar relaxation, R_{III} , is known to occur for small rare-earths in calcium fluoride; however, the relaxation exists at smaller concentrations in calcium fluoride and is stable for larger rare-earths in strontium fluoride.

GRAHAM, Billie J., Associate Professor, "Application of Solar Energy to Continuous Belt Dehydration," Solar Energy Conference of the American Society of Mechanical Engineers (ASME), ASME publication 79-Sol-27, (March 1979), 1-5.

A solar system utilizing a 553-m^2 (5950 ft^2) array of evacuated tube collectors has been designed to augment the heat supplied by natural gas to a Proctor and Schwartz continuous belt dryer used for processing onions and garlic at the Gilroy Foods plant in Gilroy, California. It has been calculated that the array, which contains 3216 evacuated tubes, will contribute 2.47×10^{12} J/yr (2340 MBTU/yr) to the dehydration process. The system has been installed and is currently being checked out for beginning full time operation in May 1979.

SCHNEIDER, Carl S., Associate Professor, and John P. ERTEL, Assistant Professor, "Experiments on Magnetic Materials," American Journal of Physics, 46 (August 1978), 820.

The construction and use of a simple apparatus to measure the magnetization density and magnetic susceptibility of ferromagnetic, paramagnetic, and diamagnetic solids and liquids are described. The apparatus is valuable in demonstrations, student laboratories, and undergraduate research.

SCHNEIDER, Carl S., Associate Professor, "Magnetoelastic and Vibration Effects of the Ultraservice Steels," DTNSRDC Report PAS-79-4, May 1979.

Magnetic permeability was expanded in a Taylor series. Coefficients of this expansion were measured for reversible and irreversible changes in the magnetization of HY80, HY100 and HY130 steel. Measurements were made on samples of these materials that had been fabricated in the form of cylindrical rods and toroids. Changes in magnetization were produced by varying the strain and magnetic field intensity applied to the rods. Only the magnetic field intensity was varied in the toroids. The measured results are consistent, and they largely agree with results reported by others. New data and models of magnetoelastic behavior of these steels are presented.

SHELBY, Robert N., Associate Professor, co-author, "Deep Levels in Be-Implanted GaAs," Institute of Physics Conference Series Number 46: Defects and Radiation Effects in Semiconductors, (September 1978), 487-491.

Electron and hole traps have been observed in epitaxial layers of n-type GaAs which were implanted with Be^+ ions and annealed at 800°C . The energy, relative concentration, and prefactor for these traps were determined using deep level transient spectroscopy (DLTS) techniques. These traps are considered to be associated with residual damage induced by the implantation process and give evidence of long-range motion of defects.

SMITH, Michael K., Midshipman 1/C, "Dipolar Effects in Rare-Earth Doped Alkaline-Earth Fluorides," Trident Scholar Project Report Number 99, Nimitz Library, U. S. Naval Academy, Annapolis.

Audio frequency dielectric relaxation measurements from 5.5-380K and ionic thermocurrent measurements from 90-290K have been used to study the relaxation of dipolar defects in several calcium fluoride samples doped with two rare-earths. Four of the five strong relaxations that occur in rare-earth doped calcium fluoride were studied. A fit of the dielectric relaxation data for the R_I relaxation region reveals that the R_I relaxation is associated with a simple-point defect. This site is assigned to the reorientation of a nearest neighbor interstitial fluorine ion around a single rare-earth. The R_{II} relaxation is also shown to be associated with a simple-point defect. New relaxations are observed in the R_{II} region in doubly doped samples and are assigned to the stabilization of R_{II} sites for rare-earths that do not form this site in singly doped crystals. Activation energies for these relaxations are 0.170 eV. for samarium and 0.182 eV. for praseodymium. New relaxations are observed in the R_{III} and R_{IV} regions. These new relaxations are assigned to hybrid cluster-sites within the samples. On the basis of previous optical, concentration dependence, and thermal studies the R_{III} relaxation is associated with a site containing three rare-earths, a trimer. Since only one new relaxation is observed in the R_{IV} region this relaxation is assigned to a site containing two rare-earths, a dimer.

SMITH, Michael K., Midshipman 1/C, and John J. FONTANELLA, Associate Professor, "Electric Dipole Relaxation of Mixed Clusters in Double Doped CaF_2 ," Bulletin of the American Physical Society, 24 (1979), 377.

Audio frequency dielectric relaxation measurements from 150-400K and ionic thermocurrent measurements from 90-290K have been used to study the relaxation of dipolar defects in several calcium fluoride

samples doped with two rare-earth species. In particular, the region containing the R_{IV} relaxation for the corresponding singly-doped samples has been investigated. In each doubly-doped sample, relaxations are observed similar to those observed in the singly-doped samples. In addition, a new relaxation is found which falls between the R_{IV} relaxation peaks of the two constituents. This suggests that R_{IV} is associated with a cluster including two rare-earths (a dimer) and that the new peak is associated with a cluster including two different rare-earths (a mixed dimer).

TREACY, Donald J., Associate Professor, co-author, "Photodarkening and Photostructural Effects in Glassy As_2Se_3 and As_2S_3 ." Bulletin of the American Physical Society, 24 (1979), 243.

Two-phonon infrared (IR) absorption, one-phonon Raman scattering and ^{75}As nuclear quadrupole resonance (NQR) measurements were performed on a series of pure and doped As_2Se_3 bulk glasses and films. These experiments were combined to study the relation between the photodarkening effect (the shift of the fundamental absorption edge to lower energies upon irradiation with near band-gap light, 10^2 - 10^3 cm^{-1}) and photostructural effects (light-induced structural changes). This systematic study shows that the photodarkening effect occurs with no concomitant photostructural effects in (1) bulk As_2Se_3 and As_2S_3 , (2) bulk As_2Se_3 doped with I, and (3) films of As_2Se_3 evaporated onto substrates at 450K (whose transport properties are known to approximate those of the bulk). No changes were observed at 77K in the two-phonon IR and the one-phonon Raman spectra or in the NQR line-shape after irradiation. The NQR measurement is most significant because the NQR frequencies are extremely sensitive to subtle changes in local structural order. Photostructural changes were, however, observed in films deposited onto a 300K substrate.

WINTERSGILL, Mary C., Assistant Professor, co-author, "The Effect of Radiation on the OH^- Infrared Absorption of Quartz Single Crystals," Bulletin of the American Physical Society, 24 (1979), 449.

Irradiation of Sawyer Electronic Grade quartz crystals at 300K lowers most of the OH^- related infrared absorption bands but produces additional bands at 3306 and 3367 cm^{-1} . All infrared measurements were made at 80K. The 3306 cm^{-1} band is about 1/3 as strong as the 3367 cm^{-1} band. If the sample is subsequently irradiated to a dose of 0.5K Joule/ cm^3 at 80K, the 3306 cm^{-1} band grows at the expense of the 3367 cm^{-1} band until they reach nearly equal strength. Upon annealing, the two bands

keep their equal strength until 230K, where they quickly switch back to the original room temperature ratio. A dose of 2K Joule/cm³ at 80K completely suppresses these bands; upon annealing they grow in with equal strength above 110K. The production of the 3306 and 3367 cm⁻¹ bands versus temperature during irradiation has been measured; the bands start to grow in above 200K.

WINTERSGILL, Mary C., Assistant Professor, co-author, "Nonlinear Response of TL in LiF Dosimeter Material to Mixed Dose Rates," Health Physics, 35 (1978), 498-499.

Previous studies of the dose-dependence of TL in LiF TLD material with γ or X rays have usually shown LiF to have a linear response up to 3.0×10^3 rads. The present work reports indications that while linearity is a valid assumption for doses of a single type of radiation, when two different qualities of radiation are involved, a linear response should not be expected. The response of LiF samples with various Mg and Ti doping-levels to sequences of γ and β irradiations was investigated. Effects ranging from suppression of TL peak 5 by a factor of 1/2, to enhancement of peak 5 by 25% have been observed. The effect of a particular combination of irradiations seems to depend both on the Mg and Ti doping levels of the sample and on the sequence of irradiations to which the sample is exposed.

PRESENTATIONS

PHYSICS DEPARTMENT

BEAM, David A., Midshipman 1/C, Donald J. TREACY, Associate Professor, John J. Fontanella, Associate Professor, "Changes in Charge Compensation Configurations in $\text{CaF}_2:\text{Er}(3+)$ When Quenched," 1979 March Meeting of the American Physical Society, Chicago, Illinois, 19-23 March 1979.

ELDER, Samuel A., Professor, "Forced Oscillations of a Separated Shear Layer With Applications to Flow Tones." Hydromechanics Seminar, David W. Taylor Naval Ship Research and Development Center, Carderock, Maryland, 25 January 1979.

ELDER, Samuel A., Professor, co-author, "Tone Generation Due to Laminar Flow Over a Cavity Mounted in a Flat Plate," 97th Meeting of the Acoustical Society of America, Cambridge, Massachusetts, 15 June 1979.

FONTANELLA, John J., Associate Professor, Mary C. WINTERSGILL, Assistant Professor, and Richard L. JOHNSTON, Associate Professor, "The Dielectric Properties of As-Received and Gamma Irradiated Fused Silica," 1979 March Meeting of the American Physical Society, Chicago, Illinois, 19-23 March 1979.

GRAHAM, Billie J., Associate Professor, Maido SAARLAS, Associate Professor, et al., "Application of Solar Energy to the Dehydration of Onions," Solar Industrial Process Heat Conference, U. S. Department of Energy, 18 October 1978.

GRAHAM, Billie J., Associate Professor, "Computer Augmented Video Education (CAVE) for Basic Physics," Maryland Association for the Educational Use of Computers, Fall Symposium, Towson State University, 16 November 1978.

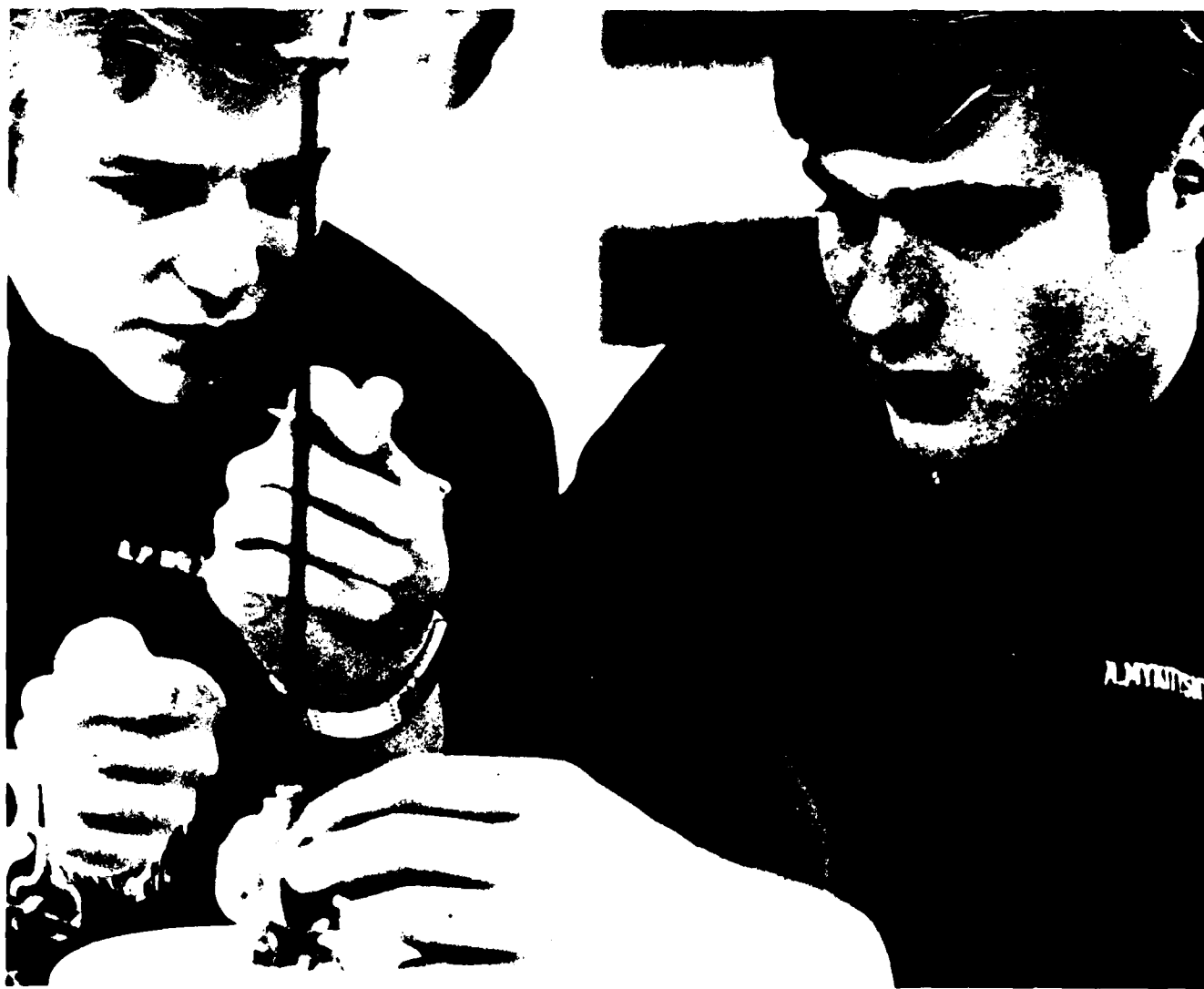
SCHNEIDER, Carl S., Associate Professor, "Magnetoelastic and Vibration Effects in the Ultraservice Steels," Linear Chair Theory and Modeling Conference, David W. Taylor Naval Ship Research and Development Center, Annapolis, Maryland, May 1979.

PRESENTATIONS

PHYSICS DEPARTMENT

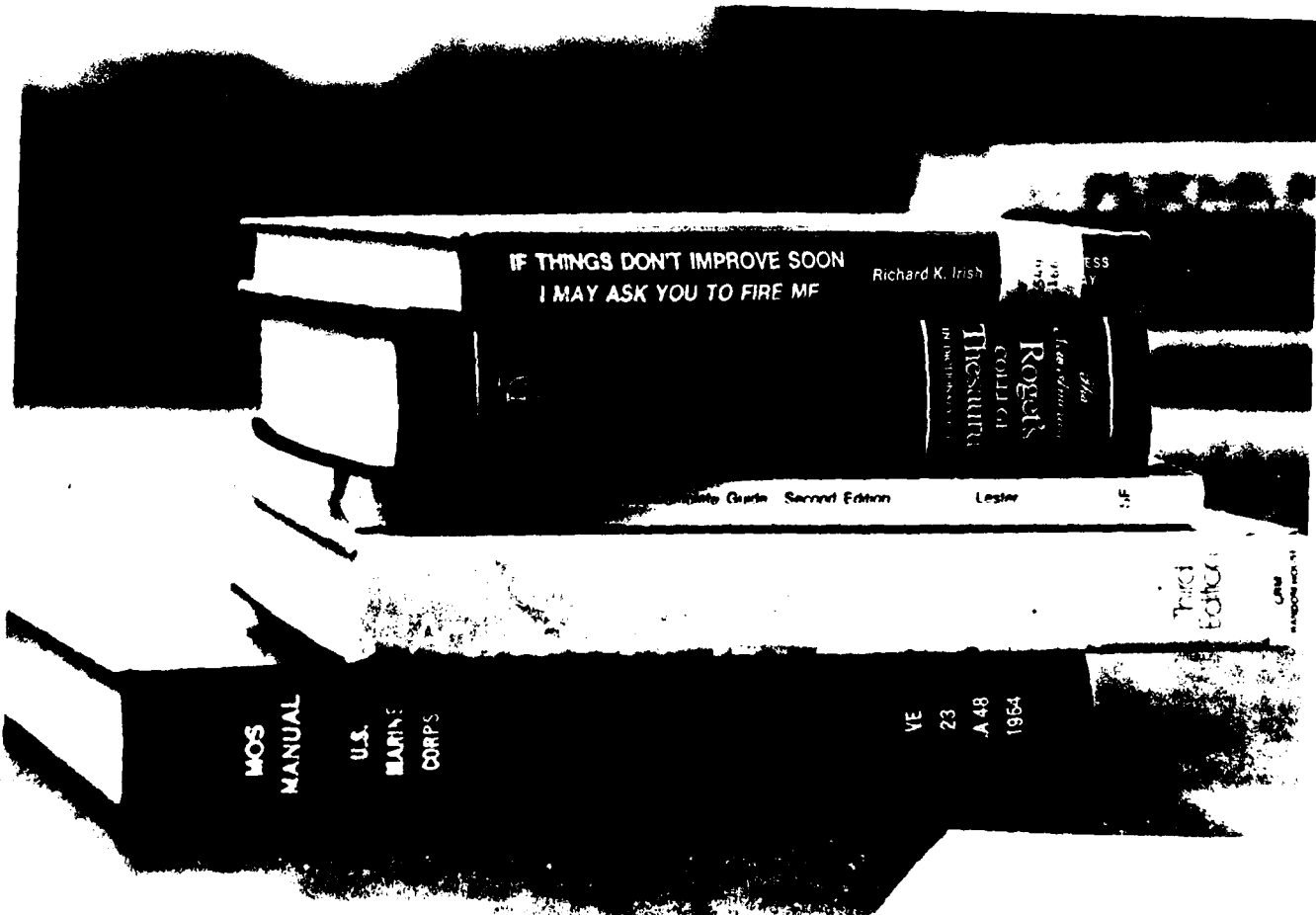
SMITH, Michael K., Midshipman 1/C, and John J. FONTANELLA, Associate Professor, "Electric Dipole Relaxation of Mixed Clusters in Double Doped CaF_2 ," 1979 March Meeting of the American Physical Society, Chicago, Illinois, 19-23 March 1979.

TREACY, Donald J., Associate Professor, co-author, "Photodarkening and Photostructural Effects in Glassy As_2Se_3 and As_2S_3 ," 1979 March Meeting of the American Physical Society, Chicago, Illinois, 19-23 March 1979.





DIVISION OF
PROFESSIONAL DEVELOPMENT



LEADERSHIP AND LAW DEPARTMENT

Commander John D. Luke, USN, Chairman



Research programs conducted by the Leadership and Law Department are designed to provide outcomes useful to the operation of the Brigade of Midshipmen and to the development of the Leadership and Law curriculum. Members of the staff design and implement individual research problems and also manage programs of research that involve other organizational components of the Navy. They also conduct programs involving the combined resources of the other service academies. Assistant Professor Patrick R. Harrison acts as Division Research Coordinator.

SPONSORED RESEARCH

LEADERSHIP AND LAW DEPARTMENT

**AN ECOLOGICAL MODEL OF CAREER DEVELOPMENT FOR SURFACE WARFARE OFFICERS
IN THE U.S. NAVY**

Researcher: Assistant Professor Patrick R. Harrison

Sponsor: Naval Academy Research Council

This research has three major objectives: (a) the development of a conceptual model of career and adult development, (b) the development of quantitative models to handle sequential lifespan developmental data, and (c) the use of these models to describe and analyze the surface warfare officer development system.

Objective (a) has been completed. The model is derivative from general systems theory and is interactive. The coordinate hierarchical interactions of behavior and environment within an evolutionary perspective provide the basis for problem analysis. The quantitative modeling is being studied using a covariance matrix with defined properties. Several studies using the model to generate hypotheses are under way.

COUNSELING AND RETENTION

Researchers: Assistant Professor Patrick R. Harrison and Lieutenant Harry B. Murphy, MSC, USN

Sponsor: Naval Academy (Division of Professional Development)

This research was designed to validate the counseling program offered by the Division of Professional Development by measuring the impact of counseling on various aspects of midshipmen life at the Academy. A large number of midshipmen who have used the counseling service or who were currently in therapy were asked to make a confidential assessment of the counseling process and to describe the impacts it had on them in terms of staying at the Academy, military performance, academic performance, relationships with classmates, self-awareness, and relationships with family and friends outside the Academy. Initial analysis of data is complete and portions were presented at the Annual Service Academies Counseling Conference at the U. S. Military Academy in April of this year. Approximately 80% of the respondents felt that counseling had a positive impact on their decision to stay at the Academy and on their relationships with family and friends outside the Academy. Over 90% felt that counseling improved self-awareness. Sixty-five percent felt that counseling had a positive impact on military performance. Few felt that it affected academic performance or relationships with classmates.

SPONSORED RESEARCH

LEADERSHIP AND LAW DEPARTMENT

A SYSTEMS MODEL OF THE INTEGRATION PROCESS: A MANDATED SYSTEM

Researcher: Assistant Professor Patrick R. Harrison

Sponsor: Naval Academy (Division of Professional Development)

This study develops a systems model of the integration process. The model is organized around the concept of ecological levels and levels of organization in behavior. The primary unit of analysis is the interactions between the ecological and behavioral subsystems. The model will be open but will include closed developmental processes on some levels. Because the integration process is mandated, tradition, as viewed from a socio-cultural evolutionary viewpoints, will be used to initialize and set boundary conditions. The model is hypothesis-generating. This project will be presented at Military Operations Research Symposium in June of this year at the U. S. Military Academy.

WOMEN MIDSHIPMEN'S PERSONAL PERCEPTION OF THE INTEGRATED PROCESS

Researchers: Assistant Professor Patrick R. Harrison and Lieutenant Patricia C. Garvin, MSC, USN

Sponsor: Naval Academy (Division of Professional Development)

This study was designed to capture critical incidents that either contributed to or detracted from the individual women's integration and involvement with the USNA experience. The study was cast in a cross-sectional design with the following objectives: (a) to create data useful in the analysis of critical incidents that have influenced the personal perception of the women as to their place in the program and to make across-classes comparisons, (b) to provide a basis for defining variables for more restrictive quantitative studies of integration, and (c) to provide information useful for the overall evaluation of women's integration and to make comparisons with women in other engineering programs.

The descriptive analysis of the data has been completed and was presented at the Annual Service Academies Conference on the Integration of Women, November 1978. Additional analysis is in progress.

DEVELOPMENTAL STRUCTURE IN THE ORGANIZATIONAL AUTHORITY SYSTEM

Researcher: Midshipman 1/C John Palmer

Adviser: Assistant Professor Patrick R. Harrison

This research looks at the formal authority structure at the Academy as a developmental process that each midshipman tracks through. The project has two parts: first, to model this developmental process; and second, to use the model to predict performance and attrition for particular subsets of the midshipman population such as Napsters or fleet entries. The object is not to identify high attrition groups but to identify the typical developmental profile at time of entry and the effects this entry-profile has at different points in the program. The design for the project is a cross-sequential design with cohort controls. The first sample was taken this spring with equal samples of men and women from each class with the exception of the Class of 1979. The data consisted of a substantial questionnaire which measured organizational climate, perception of power, response to authority, perception of plebe summer, and a number of specific variables suggested by behavioral observations in Bancroft Hall. The data has been subjected to descriptive analysis and has been factor-analyzed. The initial model has been constructed and further analysis is in progress.

PRESENTATIONS

LEADERSHIP AND LAW DEPARTMENT

HARRISON, Patrick R., Assistant Professor, and Patricia C. GARVIN, Lieutenant, MSC, USN, "Women Midshipmen's Personal Perception of the Integration Process," Service Academies Conference on Women, U.S. Military Academy, November 1978.

HARRISON, Patrick R., Assistant Professor, and Harry B. MURPHY, Lieutenant, MSC, USN, "Counseling and Retention at the U.S. Naval Academy," Third Annual Services Academies Counseling Conference, U.S. Military Academy, April 1979.

HARRISON, Patrick R., Assistant Professor, and Harry B. MURPHY, Lieutenant, MSC, USN, "A Systems Model of the Integration Process: A Mandated System," Military Operations Research Symposium, U.S. Military Academy, June 1979.

POINTER, H. S., Lieutenant, JAGC, USN, "Status of Forced Agreement, Due Process, and Fair Trial: The Japanese Experience," American Political Science Association, New York City, August 1979.





DIVISION OF
U. S. AND INTERNATIONAL STUDIES

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ECONOMICS DEPARTMENT

Associate Professor Clair E. Morris, Chairman



One measure of the vitality of a faculty is its research activity. By such a standard, the Economics faculty continues to show outstanding strength as judged by the increasing number of articles published and papers presented to professional societies. The interest of the faculty has been on predominantly mainstream topics that have covered such areas as the effect of government regulations on financial institutions, the returns to vocational training in the military, the non-farm employment aspects of development in third-world nations, the economic aspects of religious institutions,

and the formation of a realistic dynamic model of the economy. The researchers have used diverse methodological approaches, most trending toward quantitative analysis that makes use of multiple-regression techniques for the testing of empirical data. This year much of the Department's research effort has been funded, either through the Naval Academy Research Council or another government agency.

Research adds an important dimension to the professional activities of the faculty. It enriches and enlivens classroom instruction while at the same time it enhances the prestige and status of the Naval Academy as a quality learning institution.

MORTGAGED BACKED BONDS AND SAVINGS AND LOAN ASSOCIATION ACTIVITY

Researcher: Assistant Professor Rae Jean B. Goodman, Brookings Fellow

Sponsor: Federal Home Loan Bank Board, Office of Economic Research

Savings and Loan (S&Ls) associations were authorized to issue mortgage backed bonds (MBB) in 1975. Since 1975, savings and loan associations have taken increasing advantage of this alternative source of funds, especially during the tight mortgage period of 1978 and 1979. The objective of this research is two-pronged: (1) to determine how the S&Ls that issue MBBs differ operationally from the S&Ls that select not to issue MBBs, and (2) to determine if the ability to issue MBBs has aided the mortgage market in any statistically significant manner. The data base is the semi-annual data collected from each savings and loan association by the Federal Home Loan Bank Board. Multiple-regression analysis and other econometric techniques have been applied to this data, and a preliminary paper is available on the different characteristics of participating and non-participating associations. Further tests remain to be done; this study will continue for the remainder of 1979.

POLICIES AND ISSUES OF LOCAL MORTGAGE REVENUE BOND PROGRAMS

Researcher: Assistant Professor Rae Jean B. Goodman, Brookings Fellow

Sponsor: Federal Home Loan Bank Board, Office of Economic Research

There were many facets to this study. It was directed toward: (1) explaining the operation of the original issues of mortgage programs financed by tax-exempt revenue bonds issued by local municipalities and counties; (2) discussing the program benefits and the potential for program expansion (Constitutional as well as behavioral constraints included); (3) discussing the impact on financial institutions with special emphasis on Savings and Loan institutions (which provide 50% of mortgages issued); (4) discussing the relation between the local mortgage programs and the State Housing Finance Agencies; (5) discussing the relation of these mortgage programs, S&Ls associations, and Federal Home Loan Bank Board (FHLBB) Programs to meet community needs; and (6) proposing policy alternatives for the FHLBB's response to these mortgage revenue programs. Methodology was diverse and included a collection of historical data and facts along with substantial economic analysis that used basic elementary principles. This study has been completed and has culminated in a paper that was presented to a professional meeting and in an article that has been published.

SAVINGS AND LOAN ASSOCIATIONS AND CONSOLIDATED TAX RETURNS

Researcher: Assistant Professor Rae Jean B. Goodman, Brookings Fellow

Sponsor: Federal Home Loan Bank Board, Office of Economic Research

The U.S. Treasury Department has proposed regulations which would change the method by which thrift institutions calculate the bad debt deduction. The objective of this study was to estimate the impact of the proposed regulations on Savings and Loan Associations (S&Ls). Using data which the Federal Home Loan Bank Board had on S&Ls and service corporations, statistical tests were employed in order to formulate the potential impact on assets, liabilities, and earnings of these thrift institutions. The investigation, which has been completed, found that the impact would be substantial for a few parent S&Ls, but for most of the associations the tax burden would not affect their continued operation significantly.

TAX INCENTIVES FOR SAVINGS DEPOSITS

Researcher: Assistant Professor Rae Jean B. Goodman, Brookings Fellow

Sponsor: Federal Home Loan Bank Board, Office of Economic Research

More than thirty bills have been introduced into Congress since January 1979 for the elimination of tax, or a portion thereof, on interest earned on savings deposits. The objective of this research involves analyzing the economic impact of such tax elimination policies, i.e., what is the economic rationale, what will be the tax-expenditure impact, what will be the savings flow impact, and what are the alternatives to such policies. The data base for the estimates of the savings flows comes from the information on the money market certificate which was introduced in June 1978. Numerous statistical tests will be conducted on this data base and a mathematical model will be built to make projections about potential impacts from the elimination policies. This research is currently continuing with the prospect of completion by July 1979. A preliminary paper is available.

LIFE CYCLE RETURNS TO MILITARY SERVICE

Researchers: Associate Professors Roger D. Little and J. Eric Fredland

Sponsor: Naval Academy Research Council

This project represents a follow-on to research done under a NARC grant in Fiscal 1977. The objectives of this stage of the work are: (1) to investigate the hypothesis that long-term life cycle returns to military service are large enough to outweigh any short run penalties; (2) to investigate the hypothesis that there are positive long-term life cycle returns to military vocational training in addition to those accruing to military service; (3) to investigate the validity of the "bridging environment" hypothesis using a new data set; (4) to examine the problem of selection bias as it relates to the theory of human capital; and (5) to investigate the impact of human capital investment on self-employed individuals.

All objectives are being pursued empirically. Data are from the older male-worker cohort of the National Longitudinal Survey.

ASPECTS OF THE RURAL TOWN AS AN URBAN PLACE: RETURN MIGRATION,
ENTREPRENEURSHIP AND SKILL LEVELS IN CENTRAL LUZON

Researcher: Assistant Professor Arthur Gibb, Jr.

This investigation examines evidence from a Central Luzon case study as to the prevalence of return migrants among the entrepreneurs and workers in manufacturing and transportation activities. The study has two objectives: first, to assess return migration as a measure of the willingness of rural migrants to return to rural towns if employment opportunities are available; and second, to assess the degree of isolation of the rural economy from urban influences, especially in terms of skills levels, technical information, and attitudes.

Data are presented on the age, education, and work experience of entrepreneurs and workers in seven manufacturing categories. It is found that typically half or more of the entrepreneurs and one-fifth of the workers in these activities are return migrants.

Similar data are presented on drivers of light transportation vehicles. In addition, these data are disaggregated by place of residence. These drivers of motorized vehicles are found to be distributed in proportion to the population in the rural economy, a majority being from farming villages. One-fifth were return migrants. They tend to be young, closely linked to the agriculture sector, and a bridge between the town and village.

The study concludes that, in Central Luzon, rural non-agricultural employment constitutes an acceptable alternative to employment in major urban centers, that this is true in virtually all activities, and that the linkages between the rural economy and major urban centers are close and continuous.

SPONTANEOUS NON-FARM EMPLOYMENT GENERATION

Researcher: Assistant Professor Arthur Gibb, Jr.

This is a case study of labor absorption in non-agricultural activity in Central Luzon. The purpose of the study was to estimate the magnitude of agriculture-based non-agricultural employment and to estimate the elasticity of such employment with respect to changes in agricultural output and incomes.

Censuses and sample surveys of the various non-agricultural activities of a representative sub-region of Central Luzon generated the empirical evidence. The data by industry is aggregated according to the underlying source of demand for the labor involved. Three functional classes are used: consumer industries, agro-industries, and public services.

It is found that non-agricultural employment in all but public service activities has an at least unitary elasticity with respect to agricultural output and income. Consumer spending accounts for the bulk of the employment, indicating that the distribution of agricultural income is a crucial variable for labor absorption in such activities. In general, it is found that little of the non-agricultural employment is independent of the level of activity in the agriculture sector. Tests using regional labor force data suggest that the study area is reasonably representative of the rural economy as a whole.

The study concludes that the rural economy has a substantial capacity to provide employment in non-agricultural activities and that this capacity is essentially dependent on the level and distribution of agricultural income. A working paper is being circulated for review and comments.

SURVEY OF CONTEMPORARY MACROECONOMIC THEORY II

Researcher: Associate Professor A. Royall Whitaker

This study represents a continuation of a project which has as its purpose a comprehensive review of the inconsistencies between macro-economics textbooks and contemporary theory. An extensive survey of the literature has been completed, and proposed dynamic models of economic activity that resolve some of the inconsistencies have been proposed. A paper for presentation has resulted, and there are good prospects for more substantial work to come from this study.

THE MIDDLE-EAST DILEMMA

Researcher: Midshipman 1/C Richard W. Malone

Adviser: Associate Professor Roger D. Little

The purpose of this study is to outline the U.S. options available in the event of a Middle-East crisis that could potentially reduce U.S. access to needed oil supplies. Past mistakes have left the U.S. in a critical situation with respect to the Middle-East. Domestic production of oil continues to decline while consumption increases. Nearly 50% of U.S. oil needs are met by imported OPEC crude, thus causing a large dependence on an unreliable and costly source while increasing our economic vulnerability to an Arab oil embargo.

The analytical tools used in this study consisted of basic supply and demand principles, price theory, and general equilibrium analysis. The conclusions permitted within the context of the limited scope of this project are not startling. In order to forestall the potential threat that exists, decontrol of petroleum prices and projection incentives must be enacted for the long run. In the short run, the only weapon the U.S. holds is the implied threat of military action. For the next few years limited military activity may be necessary to show our resolve. Not only would these activities increase our prestige in the area but they could also give credibility to the threat of U.S. intervention if embargoes are threatened.

FREDLAND, J. Eric, Associate Professor, and Associate Professor Roger D. LITTLE, "Veteran Status, Earnings and Race: Some Long Term Results," Armed Forces and Society, 5 (Winter 1979), 244-260.

This is a report of an investigation on the extent to which a tour of military service proves economically rewarding in subsequent civilian employment. Most research by economists on the subject has focused on returns immediately following military service. Their results have indicated no significant returns. The focus here is on long-term returns when sufficient time has passed to allow ex-servicemen to overcome the temporary disadvantage, relative to those who did not serve, of lack of job tenure. Veteran status is shown to be a positive and significant variable in explaining the earnings in 1966 of groups of ex-servicemen, regardless of race, some fifteen to twenty years after their military service. Depending on the form of the equation and the definition of earnings, white veterans are shown to have earnings five to 10-percent above non-veterans, given age, schooling, and job tenure. Non-white and black veterans show even larger benefits. Their premiums are in the neighborhood of 13-15 percent.

GOODMAN, Rae Jean B., Assistant Professor, "Tax-Exempt Mortgage Revenue Bonds: Aids to Homeownership," Federal Home Loan Bank Board Journal, 12 (January 1979), 8-11.

The article (1) explains the operation of the initial issues of mortgage programs financed by revenue bonds issued by local municipalities and counties, (2) discusses the program benefits and potential for expansion of the programs, (3) discusses the impact on financial institutions and the tax exempt bond market, (4) discusses the relation between the local mortgage programs and the State Housing Finance Agencies, and (5) discusses the relation of these programs, S&L associations, and Federal Home Loan Bank Board Programs, such as Community Reinvestment.

JOHNSON, F. Reed, Assistant Professor, "The Mormon Church as a Centralized Economic System," Review of Social Economy, 37 (April 1979), 79-94.

This article draws parallels between the coordination problems encountered in the Mormon Church and those found in centrally-planned economies. Implicit church goals do not appear to be significantly different from those of any other economic system: stability, growth, and equity. Economic systems may fail to achieve their espoused goals because decision-makers do not acquire necessary information, because goals are infeasible or inconsistent, or because the incentive structure

is inadequate for promoting desired behavior. While the Mormon Church has been successful in achieving high rates of membership growth, it has been necessary to modify its aspirations in other areas in response to intrinsic conflicts among goals, changing environmental circumstances, and the increasing importance of secular values as Mormons have become integrated into an increasingly urban society.

MORRIS, Clair E., Associate Professor, "Defining Paradigms in Economics: The Case of Classical Political Economy," Atlantic Economic Journal, 7 (March 1979), 31.

This comment represents an assessment of the titled paper by Professor Lowell Johnson. The author is criticized for placing excessive emphasis on the Kuhnian definition of a paradigm for classical economics, but is praised for his groundbreaking work that adds a needed dimension to research in history of economic doctrine. Professor Johnson is urged to excerpt from the writings of the Physiocrats, Smith, Malthus, Ricardo, and Marx to support some of his more controversial contentions. It is also suggested that future scholars might appreciate many more citations, which would enable them to pursue leads that have been uncovered in this useful article.

PRESENTATIONS

ECONOMICS DEPARTMENT

FREDLAND, J. Eric, Associate Professor, and Roger D. LITTLE, Associate Professor, "Veteran Status, Earnings and Race: Some Long Term Results," Atlantic Economic Conference, Washington, D.C., 14 October 1978.

FREDLAND, J. Eric, Associate Professor, and Roger D. LITTLE, Associate Professor, "Long Term Returns to Vocational Training: Evidence from Military Sources," Chesapeake Association of Economic Educators, Baltimore, Maryland, 20 October 1978.

GIBB, Arthur, Jr., Assistant Professor, "The Agricultural Sub-Region and Employment Generation Strategies," Southern Economics Association Meetings, Washington, D.C., 9 November 1978.

GOODMAN, Rae Jean B., Assistant Professor, "Savings and Loan Associations in the Mortgage Backed Bond Market," Eastern Economic Association Meetings, Boston, Massachusetts, 11 May 1979.

JOHNSON, F. Reed, Assistant Professor, "Congruence between Economic and Biological Objectives: The Case of Tellico," and "Measuring Recreation Values: A Status Report," Conference on Multiobjective Planning, Tucson, Arizona, 27 February - 1 March 1979.

JOHNSON, F. Reed, Assistant Professor, "Substitutability, Reversibility, and the Development-Conservation Quandry," Eastern Economic Association Meetings, Boston, Massachusetts, 10 May 1979.

LITTLE, Roger D., Associate Professor, and J. Eric FREDLAND, Associate Professor, "Long Term Returns to Military Vocational Training," Tri-Service Meeting on Economics of Human Resources, San Antonio, Texas, 24 January 1979.

PRESENTATIONS

ECONOMICS DEPARTMENT

LITTLE, Roger D., Associate Professor, and J. Eric FREDLAND, Associate Professor, "Returns to Human Capital Among the Self-Employed," Southwestern Federation of Administrative Disciplines, Houston, Texas, 16 March 1979.

WHITAKER, A. Royall, Associate Professor, "Macroeconomics v. Textbooks: Consumption, Investment, and the National Income Multiplier," Eastern Economic Association Meetings, Boston, Massachusetts, 12 May 1978.





LANGUAGE STUDIES DEPARTMENT

Professor John D. Varbro, Chairman



Academic Computing Center.
invaluable.

Research interests in this Department during the past year have included Russian lexicography, 17th century German literature, military leadership in the People's Republic of China, religious-political events in Russia, and contemporary Argentinian literature.

Sources of funding have included the Defense Intelligence Agency, the Naval Intelligence Support Center, and the Naval Academy.

A notable aspect of research activities in the Department has been utilization of the Academic Computing Center. Its services and facilities have been

SPONSORED RESEARCH

LANGUAGE STUDIES DEPARTMENT

RUSSIAN-ENGLISH NAVAL DICTIONARY

Researchers: Assistant Professor Michael C. Halbig, project director;
Professor Claude P. Lemieux, Lieutenant Irmeli S.
Mäkelä, USN

Sponsor: Naval Intelligence Support Center

This project, involving the editing of a reversal of an existing English-Russian dictionary, was begun in 1977-1978 and completed in May 1979. Smooth copy, in camera-ready form, has been submitted to the sponsor. Professor Lemieux and Lieutenant Mäkelä prepared the some 50,000 entries for the new Russian-English dictionary. They also proofread the final copy, which was processed by Naval Academy computer facilities.

FAVOROV ENGLISH-RUSSIAN SHIPBUILDING DICTIONARY

Researchers: Assistant Professor Michael C. Halbig, project director;
Professor Claude P. Lemieux

Sponsor: Naval Intelligence Support Center and U. S. Naval Academy

Professor Lemieux and Assistant Professor Halbig have begun work on a new dictionary project similar to the one completed in May 1979. The new project is intended to produce a reversal of the existing Favorov English-Russian Shipbuilding Dictionary. Professor Lemieux is now engaged in editing entries, for computer processing.

AN AUTOMATED BIOGRAPHICAL FILE ON CHINESE MILITARY LEADERSHIP

Researcher: Associate Professor Daniel T. Y. Lee

Sponsor: Defense Intelligence Agency

This research, begun in 1976 with aid of the Naval Academy Research Council, has continued with support of the Defense Intelligence Agency. The researcher is developing computerized files on military leaders of the People's Republic of China. He again gathered data in Taiwan and Hong Kong during the summer of 1978 and has now completed more than 230 biographies. With assistance from Associate Professor Rodney G. Tomlinson, of the Political Science Department, he has also devised computer programs to analyze the public appearances of these and other Chinese leaders.

THE THEATER OF JACOB MASEN, S. J., VOL. I: THREE PLAYS AND SELECTIONS FROM THE POETICS

Researcher: Assistant Professor Michael C. Halbig

The purpose of this project is to present translations of Masen's Latin writings, with critical explanations and comments to follow in Volume II. The plays, Androphilus, Rusticus imperans, and Mauritius are from the 17th century, as are the poetics. This was the last century in which Latin was widely used as a literary language. The plays represent some of the best work for the theater written in Germany in this period. Because of the nationalistic bias of literary studies, however, such works in an international language, for an international audience, have tended to be neglected. The present version is meant to combat this neglect. Volume I is in the galley-proof stage. The expected publication date is the fall of 1979.

THE RUSSIAN CHURCH AND THE FEBRUARY AND OCTOBER REVOLUTIONS

Researcher: Assistant Professor Vladimir S. Tolstoy

The purpose of this project, begun in 1970, is the preparation of a history of the Russian Orthodox Church with emphasis on the Church Council of Moscow in 1917-1918, during the revolution. Basic research was done in Rome and Paris, followed by analysis of materials in the Library of Congress and at St. Vladimir's Seminary, Tuckahoe, New York. During the current year, the original manuscript of over 500 pages has been condensed and more footnotes provided, at the request of the prospective publisher. The manuscript is now being reviewed for technical corrections.

JORGE LUIS BORGES - AUTHOR IN TRANSITION

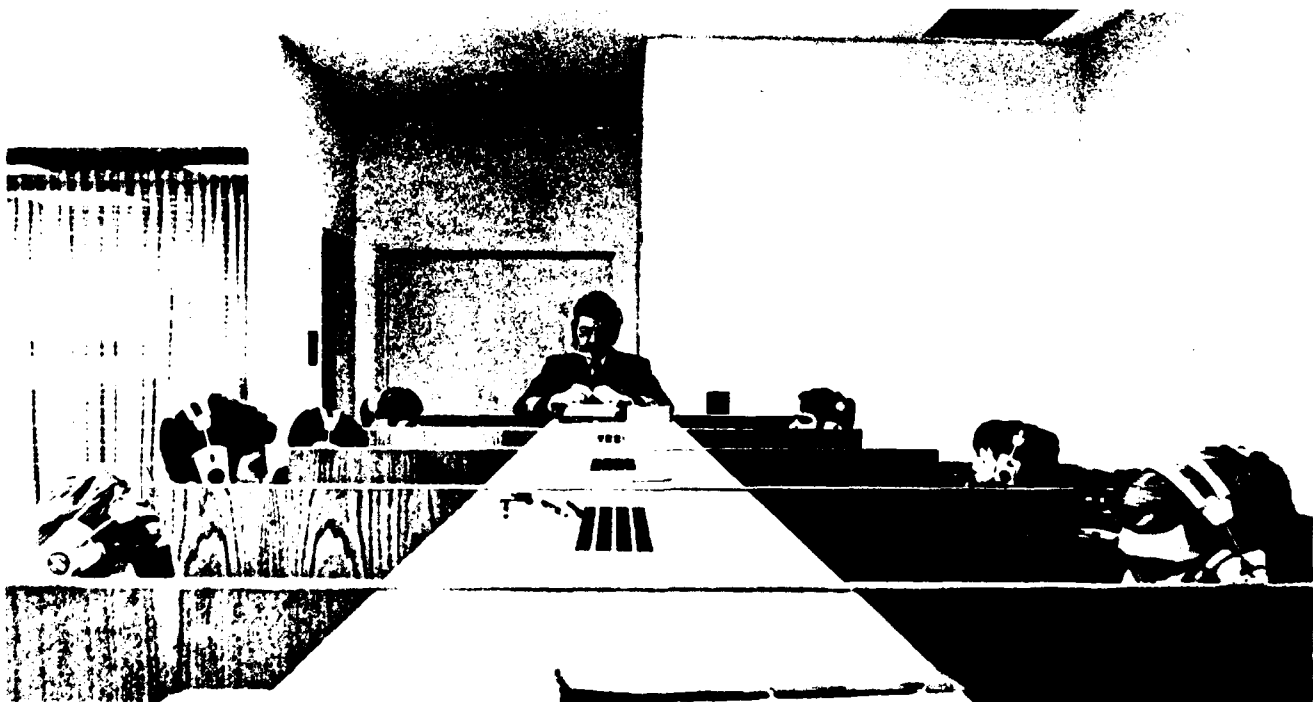
Researcher: Midshipman 1/C Douglas H. Stone

Adviser: Professor G. Pope Atkins (Political Science Department)

Midshipman Stone undertook this investigation for the course FS495, "Independent Research Project in Latin American Literature."

The works of Borges cover a wide range of topics in several literary forms. During one period in his career, with an established reputation as poet and essayist, Borges began to experiment with and to emphasize new literary motifs. A definite transition began when he published a group of fictional works termed by literary critics as "prose-essays." The first work in this category, Historia Universal de la Infamia, was followed by Ficciones, a collection of brief and imaginative short stories. El Aleph distinguished itself from earlier essayist stories and completed Borges' transition to the fictional realm.

This project explores several theories dealing with Borges' transition period. Where does humor-for-humor's-sake end and satire begin? What elements of Borges' life are reflected in his approach to fiction? An effective analysis of his fictional style derives from study of his transitional period. Borges' works were read in the original Spanish.



PRESENTATIONS

LANGUAGE STUDIES DEPARTMENT

LEMIEUX, Claude P., Professor, "A Translator's Guide to Soviet Lexicographical Aids," Annual Meeting of American Association of Slavic and East European Languages, New York City, 27-30 December 1978.

HALBIG, Michael C., Assistant Professor, "Satirical Strategies in the Epistolae Obscurorum Vivorum," Annual Meeting of Modern Language Association, New York City, 27 December 1978.





POLITICAL SCIENCE DEPARTMENT

Professor John R. Probert, Chairman



The faculty of the Political Science Department, comprised of eleven civilians and six officers, engaged in 21 research or research-related projects during 1978-1979. Five sponsored research projects were supported by the Naval Academy Research Council, the Defense Intelligence Agency, the U.S. Department of State, and the Naval Material Command respectively. One of these was a Trident Scholar projects on "U.S. Security Policy in East Asia." Four midshipmen, with faculty guidance, undertook research course projects, one of them in preparation for participation in round-tables of the Naval Academy Foreign Affairs Conference.

Of the six publications by the faculty, one, a chapter in a book on The Changing World of the American Military, was a demographic study of midshipmen characteristics and their relation to superior military performance. Another was a monograph in a series on World Energy entitled Japan's Energy Policy. Of the remaining four, three dealt with Congress and the fourth with student internships in the political science area.

The Political Science faculty gave four scholarly presentations during 1978-1979. Three were papers presented at professional meetings, and one was a lecture to an undergraduate pre-law society.

Quantitative studies, utilizing the Department's unique computer data files, characterized some of the research completed by Departmental faculty or midshipmen. Other research approaches included case studies, comparative analyses, policy studies, a review of recent American politico-economic theory and a monograph designed to enable students to learn more about the causes and consequences of presidential popularity by using voting statistics.

While some of the research effort of the Department was actually expended directly in the instructional process, all of it contributed indirectly to the enrichment and updating of instruction and to instilling a desire to learn on the part of midshipmen as they caught the contagious enthusiasm of their instructors discussing their latest research achievements.

BIOGRAPHIC ANALYSIS OF THE CHINESE LEADERSHIP

Researchers: Associate Professors Daniel T. Y. Lee and Rodney G. Tomlinson

Sponsor: Defense Intelligence Agency (DIA)

This study is an in-depth analysis of 18 characteristics of the leadership of the People's Republic of China. It employs English-text summaries prepared according to strict syntactical rules with imbedded computer flags to enable a computer to search biographies and develop summaries in the aggregate along characteristics, or to link logically different Chinese leaders as they progressed through their careers. As data fills out, it is expected that hierarchical clustering techniques will be used to establish a clear pattern of who is in charge in China. Research includes an "appearance file" wherein the public appearances of Chinese leaders are noted and coded for linkage to the biography file.

The research is, of course, a continuing effort as it strives to maintain current analysis.

ENERGY SEMINAR AND LECTURE SERIES

Researcher: Professor Rocco M. Paone

Sponsor: Naval Academy Energy-Environment Study Group
(Navy Energy and Natural Resources Research and Development Office)

This project was planned during the summer of 1978. It consisted of seven seminars followed by seven lectures. It offered a balanced program, consisting of the following topics: DOD-USN Energy Program; Politics and Economics of the USN Energy Budget; USN's Synthetic Fuel Program; Nuclear Power Energy; USN, Energy and NATO; USN Ship Conservation Energy; and Solar and OTEC Energy Conversion. The speakers included Dr. Peter Waterman, Special Assistant, Energy, USN Research and Development; Captain Thomas Stallman, USN, Director, Office of Navy Energy and Natural Resources; LCDR Larry Lukens and Dr. Allen Roberts, Energy Research Office, DTNSRDC; Dr. David Rossin, Commonwealth Edison, Chicago, Illinois; Ambassador Robert Ellsworth, former U.S. Ambassador to NATO and Deputy Defense Secretary of Defense; Dr. Cyril Krolick, Technical Administrator for Energy Research and Development, USN; and Dr. Robert Cohen, Program Manager, Ocean Systems Branch, Department of Energy.

The series was designed to afford interested faculty members the opportunity to discuss, in afternoon seminars, various points of common interest with the guest specialists. The evening lectures were attended by both faculty and midshipmen.

The afternoon seminars were attended by an average of some 17 faculty members from the Engineering, History, Chemistry, and Political Science Departments and reflected, at times, sharp differences of opinion and many constructive exchanges of information. The evening lectures, attended by an average of 125 midshipmen and faculty members, were more formal and also were constructively informative. As a rule, the Energy Seminar/Lecture Series aided listeners in directing research projects toward various areas of energy.

DIPLOMACY AND THE EVOLUTION OF ASEAN: POLICY FORMATION IN A MULTI-LATERAL COMMUNITY

Researcher: Associate Professor Robert L. Rau

Sponsor: Naval Academy Research Council

The Association of Southeast Asian Nations was formed in 1967 with Indonesia, Malaysia, Philippines, Singapore, and Thailand as members. The ASEAN region has been historically characterized by intraregional warfare, suspicion, and hostility. ASEAN was formed in order to work toward a collective spirit of cooperation and ideally toward mutual economic cooperation and political understanding. Progress has been made, in varying degree, toward these objectives. As of 1978, the increasing importance and effectiveness are evident. ASEAN has conducted two significant meetings with the U.S. government and has extracted promises of major trade concessions and loans for its member countries from Japan. The study seeks to measure the role of diplomatic interaction in the evolution of the organization. The following questions are addressed: What are the political relationships? Who are the motivating personalities? How has ASEAN developed structurally? How are decisions made on major issues and by whom?

This analysis measures, qualitatively, the effects of diplomatic activity, e.g., leadership intervention, collaboration, public relations, exchanges for various purposes, and public announcements. The progress of ASEAN is traced from 1967 to 1978 with major emphasis on the 1976 to 1978 period.

The study has been made through the analysis of speeches, documents, articles, press reportage and interviews.

Tentative conclusions of the study suggest that ASEAN has survived a series of stressful periods and intra-organizational relationships. (The Philippines' claim to territory in Malaysia is still unresolved, with little progress seen.) A significant number of negative aspects of ASEAN have been observed, with little progress toward collecting solutions to the main objectives of the organization. On balance, however, the organization has made impressive strides toward solving its political and security problems. Finally, diplomatic activity and interaction are responsible for observable progress rather than central direction from the ASEAN Secretariat. Other factors such as external events, e.g., the increased political and economic effects of OPEC, the end of the war in Vietnam, and the increasing activity of the People's Republic of China and the Soviet Union continue to act as stimulus for progress toward cooperation and greater progress for ASEAN.

U.S. SECURITY POLICY IN EAST ASIA: THE JAPANESE FACTOR

Researcher: Midshipman 1/C Charles Robert Wright

Adviser: Associate Professor Robert L. Rau

Sponsor: Trident Scholar Program

United States security policy in the Far East is still in large measure based on President Ford's "New Pacific Doctrine" of 7 December 1975. The first point made by this doctrine is that American strength is basic to any stable balance of power in the Pacific. Significantly, the doctrine's second point emphasizes the importance of our relations with Japan in maintaining peace and stability in the area.

A more recent delineation of U.S. Far Eastern policy was presented by Secretary of State Cyrus Vance in New York on 29 June 1977 as he addressed the Asia Society. Here, consistent with Ford's New Pacific Doctrine, Vance elaborated on the importance of our relationship with Japan to the success of our efforts to build on positive East Asian developments of the last few years.

The purpose of Midshipman Wright's project was to study, in detail, how Japan and our relationship with Japan have affected the formulation and implementation of the current U.S. security policy in East Asia. Major security-related issues between Japan and the United States were analyzed through library research and interviews with government officials.

PRESIDENTIAL POPULARITY IN AMERICA

Researcher: Assistant Professor Stephen E. Frantzich

This project involves an analysis of the causes and consequences of presidential popularity. It uses economic and social variables as potential causes and performance of the president as the consequence. The research will culminate in the publication of a S.E.T.U.P.S. (Supplementary Empirical Teaching Unit in Political Science), monograph by the American Political Science Association in the summer of 1979. The monograph will include a substantive analysis of the issue, computer exercises, and two data packages for analysis.

SUBSIDIZING REPRESENTATION: HOW CONGRESSMEN SPEND OUR MONEY ON THEMSELVES

Researcher: Assistant Professor Stephen E. Frantzich

This completed research is an analysis of the office expenditures of members of the House of Representatives with special emphasis on the use of public resources in improving communication with constituents and in seeking to assure the re-election of incumbents.

THE EFFECTS OF WEIGHTED VOTING IN THE UNITED NATIONS GENERAL ASSEMBLY 1974-1977

Researcher: Associate Professor Rodney G. Tomlinson

This research reexamines the question of whether or not the voting power of members of the U.N. should not reflect the size, wealth, and importance of the members. The study concluded that any weighted voting plan would be preferable to the present plan of one member-one vote. The continuing decline of the U.S. position in the United Nations suggests that alternative voting plans might be in the U.S. interest. Eighteen plans were examined, ranging from allocation of votes by wealth and contribution to the U.N. budget (the U.S. would receive 25% of the votes), to one on population alone (China would receive the most votes). In all cases some betterment in the U.S. position would occur, based on a sampling of critical votes in the Plenary Sessions of 1974-1977. Sets of tables were included in an extensive appendix.

The completion of the report included the personal briefing of Assistant Secretary of State Charles William Maynes (International Organization Affairs).

POLITICAL THEORIES OF JOHN KENNETH GALBRAITH

Researcher: Midshipman 1/C John T. Daniel

Adviser: Associate Professor Robert A. Bender

The purpose of the project was to determine what changes would be required in our political system to successfully apply the economic theories of John Kenneth Galbraith. Mr. Galbraith, one of our outstanding and most controversial economists, has never put forward any clear-cut political theory. Yet many of the theorists studied in FP325 (American Political Thought)--James Harrington, John Adams, Daniel Webster to name but a few--argue that politics and economics are but two sides to the same coin, that political and economic power inevitably go together. The purpose of Mr. Daniel's paper was to apply this thesis to Galbraith. Using all the serious works of Galbraith, Midshipman Daniel concluded--with immense support from his research--that Galbraith believed that a powerful, centralized, socialistic, albeit democratic government was the only form possible to satisfy the requirements. Above all, the regulatory agencies would have to come completely under Presidential control to insulate them from interest-group domination. Finally, parties as we now have them in the United States would have to give way to centralized, programmatic organizations of the European type.

AN ANALYSIS OF THE PEACE PROCESS IN THE MIDDLE EAST

Researcher: Midshipman 1/C David L. Krueger

Adviser: Lieutenant Thomas E. Eckert, USN

The purpose of this project was to analyze American attempts to negotiate a settlement of the Arab-Israeli dispute, concentrating primarily on the period after the 1967 Six-Day War, and, specifically, the Camp David Accords and the Egyptian-Israeli peace treaty. The researcher explored in depth the utility of the Accords, hailed as the greatest and most promising attempt by any American administration to solve the problem, as a framework for negotiating a solution to the central issue of the Palestinians. It was concluded that while the Camp David Accords and the subsequent Egyptian-Israeli peace treaty did not adequately address the problem of the Palestinians, further U.S. initiatives and active involvement in the negotiations should result in a broader framework for settlement.

SAUDI ARABIA AND THE EGYPTIAN-ISRAELI PEACE TREATY

Researcher: Midshipman 1/C Grady H. Roby

Adviser: Lieutenant Thomas E. Eckert, USN

Saudi Arabia's reaction to the Egyptian-Israeli peace treaty has been very important for the American position in the Middle East. Saudi Arabia occupies a pivotal position today in Arab politics as well as being one of the most influential members of OPEC. Thus, the United States was understandably dismayed when the Saudi Arabians refused to support the Camp David Accords and the negotiated Egyptian-Israeli peace treaty. The research explored the roots of the problem to determine why Saudi Arabia refused to support the U.S. on this vital aspect of its Mideast diplomacy. It was concluded that the reasons can be traced to a Saudi belief that the United States is not adequately committed to protection of its position in the Persian Gulf and that they would be safer in the long run to remain with Arab mainstream politics. Furthermore, the Saudi Arabians were very upset that the Jerusalem question was not addressed in the accords or peace treaty, and they did not believe the United States was doing enough to force Israel's hand on this question.

AN ASSESSMENT OF THE EFFECTIVENESS OF ARMS TRANSFERS AS A POLICY INSTRUMENT IN THE MIDDLE EAST

Researcher: Midshipman 1/C David A. Soranno

Adviser: Lieutenant Thomas E. Eckert, USN

United States Arms Transfers have played an important role in the pursuit of U.S. Foreign Policy objectives in the Middle East. This fact has been evidenced by the quantity and sophistication of U.S. weapons deliveries to Israel, Saudi Arabia, Jordan, and Egypt since the 1967 Six-Day War. The United States, with considerable difficulty, has tried to influence Israel's policies by manipulating military aid earmarked for Israel's defense. More recently the United States has become a supplier to both sides of the Arab-Israeli dispute. As the U.S. role in the Middle East becomes more critical, one must examine how effective arms transfers have been in influencing the recipient countries to follow U.S. policy desires and must assess the value of arms as a viable foreign policy instrument when the United States is supplying both parties to the conflict.

The researcher's conclusions did not speak well for the effectiveness of U.S. arms transfers as policy. In the case of Israel, the record shows that the more arms Israel receives, the less cooperative Israel has been in accepting American initiatives. And when the arms lever has not worked, the U.S. position as a mediator has been compromised, as the Arab states see U.S. favoritism toward Israel. As far as the Arab states are concerned, arms transfers have not influenced the price or supply of oil or elicited a favorable Arab response to the Camp David Accords and the Egyptian-Israeli peace treaty. Thus, arms transfers have been a marginal foreign policy tool in Mideast diplomacy at best.



FITZGERALD, John A., Associate Professor, "Who Goes to the U.S. Naval Academy?", The Changing World of the American Military, F.D. Margiotta, editor. Boulder, Colorado: Westview Press, 1978.

This chapter is an examination of factors correlating with superior military performance at the U.S. Naval Academy. Geographic origin, class, race or ideology have not affected military performance. The two most important correlates were: (a) strong career orientation and (b) religious attachment.

FRANTZICH, Stephen E., Assistant Professor, "Expanding the Knowledge of Congress Through Computerized Information Technology," Legislative Studies Quarterly, (April 1979).

The use of modern information technology has opened the door to a possible new era of decision-making and representation in Congress. The impact of the new technology will not be neutral, but will deeply affect the distribution of power both within Congress and between Congress and its various constituencies. This paper outlines the potential for modern information technology and the political aspects of its adoption and implications.

FRANTZICH, Stephen E., Assistant Professor, "Making the Internship an Academic Experience," News for Teachers of Political Science, (Winter 1979).

Political Science internships are often devoid of real academic content. This paper outlines some practical methods for bridging the gap between political theory and political reality for students involved in internship programs.

FRANTZICH, Stephen E., Assistant Professor, "Opting Out: Retirement from the House of Representatives," American Politics Quarterly, (July 1978), 251-274.

Despite the fact that service in the U.S. Congress has often been seen as very desirable, an increasing number of members are voluntarily retiring well before one would expect. This paper discusses the reasons members give for retiring and outlines the kinds of members most likely to leave. Since retirement opens the door to the recruitment of new members, the analysis looks at the shifts in legislative behavior occurring when retiring members are replaced.

FRANTZICH, Stephen E., Assistant Professor, "Technological Innovation Among Congressmen," Social Forces, (March 1979), 968-974.

This study focuses on the process of innovation among members of a political elite. Using theories drawn from rural sociology and anthropology and applying them to the decisions of individual members of Congress to accept or reject technological innovation, it found that similar factors are at work. Innovators tend to be those most in need of change, those who are socially marginal to the system.

PAONE, Rocco M., Professor, Japan's Energy Policy. Newark, Delaware: University of Delaware Press, 1979.

This is a 150-page volume on Japan's Energy Policy since the various "shocks" of 1973-1974. It comprises a volume in a World Energy series which is edited by Dr. Gerald Mangone, Director of Maritime Studies, University of Delaware.

This study explores the domestic political and economic scenes of Japan, the country's natural resources and economic capabilities, and the effect of the energy "crunch." It then proceeds to stress the nation's energy policy since 1973, the energy demand - supply structure, the energy industries of Japan, including national energy conservation programs, and the contemporary long-range energy planning programs, including development of new sources of energy, i.e. nuclear power (considered to be most feasible), solar energy, geothermal and hydrogen energy, and synthetic natural gas (gasification and liquifaction). Much of the material for the book is from primary sources, and many tables, charts, and graphs are included.

WRIGHT, Charles Robert, Midshipman 1/C, "U.S. Security Policy in East Asia: The Japanese Factor," Trident Scholar Project Report Number 103, U. S. Naval Academy, Nimitz Library, Annapolis.

The purpose of this project was to study, in detail, how Japan and our relationship with Japan have affected the formulation and implementation of the current U.S. security policy in East Asia. Major security-related issues between Japan and the United States were analyzed through library research and interviews with government officials.

PRESENTATIONS

POLITICAL SCIENCE DEPARTMENT

COCHRAN, Charles L., Professor, "Law and the International Community,"
Pre-Law Society of Mount St. Mary's College, Emmitsburg, Maryland,
1-2 November 1978.

COCHRAN, Charles L., Professor, "Criminal Jurisdiction and the U.S.-
Philippine Status of Forces Agreement," Annual Meeting, American
Political Science Association, New York City, 30 August 1978.

FRANTZICH, Stephen E., Assistant Professor, "An Update on Technological
Innovation on Congress," National Science Foundation Short Course,
College Park, Maryland, March 1979.

FRANTZICH, Stephen E., Assistant Professor, "Strengthening the Academic
Validity of Political Science Internships: Some Possible Options,"
Midwest Political Science Association Convention, Chicago, Illinois,
April 1979.



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